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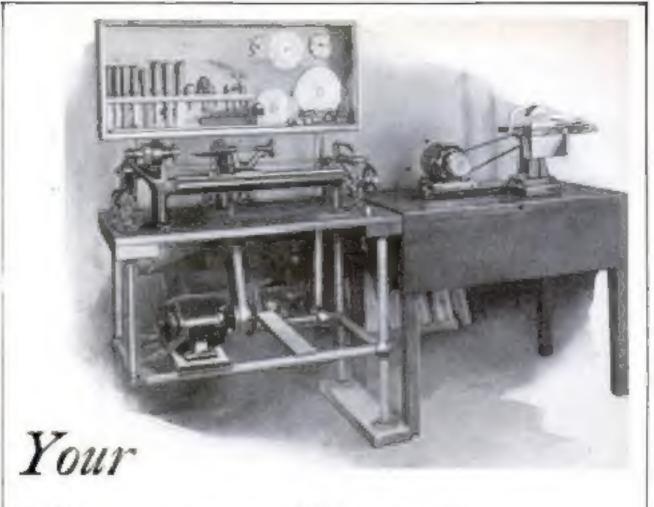
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Motorized Workshop

By R. M. BOLEN

Sources, Papalar Science Institute



With motor-driven tools, all the expert's tricks are in novice's bands

O THE dyed-in-the-wool home workshop fan, the N. R. A. means one thing in particular—more time for tools.

All over the country, thousands of men, young and old, are sharpening tools, planning new projects, and tearranging shops. With more time for play, every amateur woodworker feels that at last he can get the most out of his fascinating bobby.

But the real answer lies in motordriven tools. For until you have fed wood into the buzzing teeth of a bench saw, cut whirring spindles in a lathe, and held stock against the nibbling blades of a planer, you have missed the biggest thrills your home workshop can offer.

Like the N.R.A., motorized tools mark a new era for the amateur. Both mean

more fun, more play, and more time for the details. With motor-driven tools, all the tricks of the expert are placed in the hands of the novice. Tedious tasks are simplified and roundabout jobs shortened.

When you let electricity do the work, the usefulness of your shop is doubled. Two projects grow where one grew before. Mistakes are fewer, experience less of a necessity, and the finished products nearer perfection.

"But." you may say, "motor-driven tools are an expensive luxury. I'd like a modern shop as much as the next fellow, but I can't

afford it, so why think about it?"

At present prices, anyone who can afford a shop and a hobby can afford motorized tools. High-grade machines were never cheaper. Carefully designed lightweight shops consisting of a bench saw, lathe planer, jig saw, band saw, and motor can be bought for less than \$70 while individual units sell for little more than the price of a good hat,

In fact, good mutorized equipment is available at all sorts of prices. Like automobiles, they can be grouped into well-separated price ranges, each fulfilling a need and offering good value for the money. No matter what your requirements, there are motorized tools that will fit your pocketbook as well as your needs.

For less than ten dollars, you can place a safe, though lightweight, bench saw in your shop while (Continued on page 9)

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"The MAGIC EYE that Sees Across the OCEAN"

SEVEN years ago, in a story called "The Magic Eye that Sees Across the Ocean", this magazine reported the latest triumph of the photo-electric cell in enabling engineers to transmit long-distance pictures successfully. The photo-electric cell was then far from being a new invention. But it was still waiting, as we pointed out in this article, for the world to discover its many other uses . . . a world that thought the "magic eye" a tricky gadget whose commercial possibilities were not to be taken too seriously. But then, there will always be thousands standing on some river bank and jeering at the Robert Fultons . . . the same thousands who later cross the seas on palatial liners.

Today men are making this photo-electric cell count and check articles on production lines, sort colors and sizes, protect their homes and factories—all without human aid. Only a few months ago the "magic eye" captured a beam of light from the far-off star, Arcturus . . . and The Century of Progress at Chicago was opened in a brilliant blaze of glory.

Readers of Popular Science Monthly were quick to see the possibilities of the photo-electric cell—and among them were the first men to put it right to work, because these men recognized the authority and the timeliness of this magazine which brought—and still brings—the first reports of all new inventions and products.

Although the rest of the world is always slow to learn, you—as a reader of Popular Science Monthly—may find today the report of something new that will help you in your own business. In these pages, from month to month, you may find the hint that will give you the jump on the world... and on your competitors.

Popular Science is the news monthly of Progress—and Progress is the keystone of modern business. You can rely on this magazine for the FIRST reports of science's new ways to help you. Almost half a million men, seeking other "magic eyes", are doing so now.



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New Construction Kit Clipper Ship Model

EVERYTHING you need to make a beautiful little miniature model of the famous American clipper Sea Witch is contained in a new construction kit offered by the Popular Science Homecraft Guild. Unlike all previous elipper ship models, this one has been so greatly simplified that anyone can build it. Indeed, it is what is called a "pocketknife" model because so much of the work can be done with a penknife and a few single-edged

The hull of the model is 91/4 is, long, but the over-all length is 13 in, and it stands 8 in, high. The kit contains the hull carefully sawed to shape by hand from accurate master templates; half a dozen pieces of pine cut to approximate sizes for the deck fittings and boats; hardwood for the keel, stem, sternpost, rudder, and other parts; three sizes of round stock for the masts and spars; fiber for crosstrees and caps; thin hand-dyed linen rigging cord of the finest quality; thread, small chain, beads, fine wire, casein glue-in fact everything but the

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Write ledgy to WINDST CLUB TO Open Road For Boye 130 Mewhary Street, Booton, Mano.



But what a slave! Flexible Flyer is the speed demon on runners. Nothing can pass it, nothing can equal it but another Flexible Flyer. Every steep hill, every horseshoe curve, every straightsway calls for a Flexible Flyer. But only a coasting fan — only a stedding expert can feel the full thrill of power, the smooth speed under superb control, of Flexible Flyer — the sted unchallenged for half a century.

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Boys and girls you can have a ministure model of the famous Flexible Flyer FREE. Just send your request to the above address.

Flexible Flyer

YOUR MOTORIZED WORKSHOP

(Continued from pages)

thirty dollars will buy you a semi-professional outfit that is larger and beavier Jig saws range in price from a few dollars upward and woodworking lathes from seven dollars to over forty

Perhaps you do not want a complete motor-driven shop. Well and good. There is no need to invest in a complete outfit to enjoy some of the benefits of motor-need tools. If you buy only a good cirrular saw you will be going a long way toward modernizing your shop. It will save you time and your work will be easier and more interesting.

The same can be said of the lathe. In fact, few tools will do more than the bench saw and lathe to widen the scope of a hand-tool shop. They will be your passport to more intricate designs. Immediately your choice of projects will be greater, the output of your shop more artistic.

The first thing to do when planning a motorized shop is to decide which branches of the woodworking or metal working bobbies interests you most. Once you have analysed your interests it will be easy to pick out those tools that will add the most to your shop. In time, you will want to add others. The important thing is to motorize and enjoy woodworking the modern way

The same bolds true with the bobby of metal working. If you are interested in building model locomotives and miniature trains, your shop will not be complete until it boasts a good metal tathe. Countless model making jobs require turned parts that can be made in your own shop for a fraction of their cost ready-made

If you are like the average individual, your home workshop will be a life-long hobby. For this reason, you can bot choose your equipment too carefully Decide what you want to spend and then get the best for your money

To readers who are interested in adding motor-driven tools to their shop, Popular Science Institute offers the following advice: Send for the cutalogs of all the motorized tool manufacturers, consider the advantages of each make, and buy the equipment that best fits your pocket-book and your needs. But most important of all, buy from reputable manufacturers such as those whose products bear the seal of the Popular Science Institute

PHOTOGRAPHS WANTED

To find out more about amateur shops, Popular Science Institute is collecting photographs of hand-tool and motorised workshops. If you have a home workshop, no matter how small, take several pictures of it and send them together with a description and a list of your hobbies to Popular Science Institute, 381 Fourth Avenue, New York, N. Y.



Pleny Racer — twin brother of the famous Flexible Flyer. Flexy Racer — the Flexible Flyer on wheels — the fastest, smoothest, safest coaster in the world. Swings instantly from high to low speed — races like a thoroughbred, always under control — cuts the wind like a blade and stops in a split second.

Healthful fun from five to fifty. Light enough for boy handling sturdy enough for man handling.

Silent as a high priced motor car — positive two-wheel brakes—balanced spring steering—live rubber tires — handles like Flexible Flyer. Made to use and made to last.

All years for a merry Christmas -

Flexy Racer, the Flexible Flyer on wheels. And the new Flexy—a juntor in age and a juntor in price. Priced from \$5.05 to \$8.50.

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Our Readers Say

Go to the Bee. Thou Crooner, And Learn About Broadcasting

The excellent article by Robert E Martin, "Nature Invented Them First," could be followed by one on "Insects as Radiotriciazs." This idea is not so preposterous as it seems. Many Insects have appendages which are

neither ornaments nor weapons, yet are in some way connected with the creatures' existence. A guess that it is some form of racho communication is not so will as one might think at first glonce. By reasoning from analogy, we find some of them capable of broadcasting on



a frequency so high that it is light, which we can see. A different frequency would be intel gible only to an organ developed for that purpose. We have gone to the insects for a name for one of the most important parts of a radio broadcasting and receiving set, the antenna, many types of which we find in the insect world. Here are some of them. The horizontal antenna is used by the cockroach. The vertical entenna by the guaba, a scorpionlike creature found in the tropics. The semi-vertical antenna is used by bees and wasps. The fan-type autenna used by moths and butterfies. The ball antenna used by snails. This small globe, carrier in pairs on an extensible pole, is mustaken for the eves. A close examination of the creature will show that the eyes are in the front part of the forehead and are not movable, while the small globes are capable of being with drawn into the creature's body. The exactness with which the worker bee goes to the have with his load of police is till a mys-tery. How does he do it? Regardless of weather a rollio signal would made him as p does on aviator and may be that's what be uses -R P D San Antonin Texas

Here's One Kick at Least We Can't Be Blamed Foc

As the result of an argument on the fullowing subject, I am asking you to supply the answer, if you find the subject interesting enough to publish. What causes the kiCK in a gup? A claims the kick starts at the moment of the explosion. B claims the kick starts at the moment the builet leaves the barrel. A says the explosion must produce a kick as the builet is a resistance. It says the internal explosion in equal all

around and the hultet, offering the least resistance must move forward, but does not tkick) force the guneach. The kick is caused by the force of the explosion (not the hallet) striking the atmosphere immetiately after the bultet leaves the barrel. Every bit of informa



tion any of your readers can offer will be more than appreciated.—H.G., New York, N. Y

Inspiration Isn't Exactly What Some Would Call It

I THENK II quite remarkable that some of Port Lin Science Montrely readers are so much weser than Einstein and Jeans and Eddington and other accepted acientific authorities. Some readers have no bestiancy in telling us exactly what space, radio waves, X-rays, electrons, protons, and even the ether are. All of this remarkable information they have acquired without performing a single experiment or making one calculation. Probably they received their data through some products enuglitening form of second sight or instaration of doubtful origin. S.P.F. Los Angeles. Cabi

Descendant of Kings Makes Our Solid Scale Models

I have been making several of your solid scale models and have solid a few Now I should like to make a solid scale model of the wartime Spad and SE 5, the models to be the same scale as the Fokker D-7 I am a direct descendant of King Louis XVI of France and so would like to get a copy or description of his coat of arms—TNT, Cavalier, N D

Here's Moon Madness Setting A New All-Time Record

Or all the plans for signaling to the moon, lunar televimoon is probable the most simple. All that is needed are some water. When inhabitants of any other planel see the earth, they should be able to detect the difference between land and wat



er If we go out and dig a big mud puddle, people on the moon should see it. No fancy ratho gadgets were not mental telepathy are needed. The only requirement would be, for a puture 500 miles square about one shovel and one man per acre, for 16,000,000 acres; and about 320,000,000,000 buckets of water Wasn't R Edison who said something about genius being ginety-mane per cent error spiratum? Here a my one per cent Wash. San Francisco, Calo

Triangle Problem Draws Almost Instant Reply

Concension the right angle triangle asked for by P.C., Troy, N.Y., I'd like to say that any triangle in the proportion, short side. 1 000, long side, 1.271, hypotenuse, 1.613, will meet the conditions. His problem involving the radius of the circle as illustrated is of course merely a trick. Draw the diagonal of the remargle from the center of the circle, and the radius is obviously five inches. With record to the numbers asked for by

N.D.W., San Bernardino, Calif., there are two sets of such numbers, depending on whether the numerical value of y is plus or minus. X equals 2.518, y equals 1.518, or X equals 0.382, y equals—0.518. I note that one of your correspondents says that the soap hubble problem can only be solved by infeating. I solved it first by a gebra.— J.S.H., Tenady, N. J.

This Racing Bug Gets In a Mixup with Nitrogen

A rew days ago a crowd of us automobite racing bugs got to talking about the tricks that drivers use to win races. One of the gang told about an article he had read in some

magazine It control that the latest trick consisted of falling the tree on racing care with nitrogen gas instead of his lammed at lately everyone wanted to know why nitrogen gas was any better than his We argued for hours but couldn't come to any conclusions. My guess



was that it had something to do with the relative speeds of diffusion of nitrogen and and air through the rubber and fabric to walls. Someone else seemed to think that it had something to do with expansion and heat. What do you think? Perhaps some of your cenders who know a little more than we do about it can set us straight—J k F Cincinnati. Ohio

World Fair Exhibit Was "Simply Wonderful"

I have just come back from the World's Fair at Chicago. I haw your exhibit there and I can't tell you how much I enjoyed it The way those gears worked is simply wonderful.—HWK., Omaha, Nebr

Stalin Won't Thank You for Bringing This Matter Up

Too bad, in your article last month on the weather, that you didn't give some space to the great and glorious work of the Soviet Commission for the Prevention of Snow all over Cities. Last winter, the papers told us the Soviet Government got the idea that it would save a lot of trouble for the street-

rienning squads if snow didn't lad, so it decided to aboush it. The technical experts said it could be done by sending up observation ballooms with electric somestion apparatus whenever snow threatened Pechaps for their his demonstration they del berately chose, as



same truelly suggest, a day when no snow was expected anyway. But greatly to their

consternation, hardly had they got their apparatus working when snow began to fall in great white flakes. Since then, strangely enough, I haven't seen a thing in the news about the Soviet Commission for the Prevention of Snowfall over Cities.—G.H.W., Durath, M on

Colorado River Toad Is New Expert on Perfumes

Source time ago there was a question submitted to "Our Readers Say," concerning possenous frogs, or toads. Your readers prob-

ubly have heard of the Colorado River toad which makes its home along that river, and throughout the Southwest. The color of this toad is a muddy green. It is a huge fellow, and is capable of exuding a poisonous substance from his skin Many a small dog has gone



to the happy bunting ground after bring one of these tonds. Men have become ill from handing the toad, but I have never heard of a fatglity. Like most pursonous things, this toad has a method of warning offenders—a very disagreeable onor I speak from first-hand experience as six of the toads make their home in my garden but do not bother us in the least unless they are distorbed. They wage an entires war on worms and insects, and for that reason I consider them an asset—E.W. B. Winkelman, Aris.

Here's One Final Blait At All Evolutionists

J H P., I do not know whether to be sorry for you or ? Augh at you. Any embey the gist knows that there is no amitable at strucfure or unition between the human emission and the fish. The so-called gill-slits are nothing more per less than pharenceal arches They are gills in no sense of the word, and if they were, would afford no proof of the theor of evolution, for the argument from smalarity has been exploded. When a theorist resorts to such leadle supports he is weak index f As for the Bible, it contains no fairstors up rue statement, or tailing so prove able by any established modern scames. Are you well acquainted with the entire contents of the Bible and with the pertinent findings of archeology? Until you have as symmetric both sides of the argument you have not shown indeflectual honesty -W.H.R. Jr. Montestown N. J.

If You Get Past This One. We'll Have a Hard Winter

For centuries, human beings have attempted to unveil the mystery that surrounds their existence on earth only to meet with complete failure. The hulden barrier that so consistently guards the secret of creation can not be passed by mankind, and the theories that scientists are constantly ad-

vancing are worthless flow can man, a mere mechanism, hope to penetrate into the Great Bewond? Is it not enough that we are here and enjoy li e? The thought of man solving the engma of life is socredible! Gradually, the wise man comes to



the conclusion that hie is too sacred a thing to be a subject or controversy among mere mortals, and so he leaves the question dangling in mid-air, un-

answered.-F.B., Reading, Pa.

Bottling Ether Is Difficult Since No One Can Find It

Preservine to tell you, E.C.J., Westport, Conn., that ether is not a material substance as supposed by many but merely a concept that was originated in the nineteenth century because of the apparent necessity for some medium to transmit light and electromagnetic waves. The Theory of Relativity, while still a theory, disproves the existence of an other Your scheme for bottling ether will not work since ether does not exist in the form in which you have concrived it.—

J.T., Shady side, Ohio.

Pull of Those Horses Depends on Conditions

ANSWERING a question in a recent issue from O.L.G., Rockton, Ill., regarding the relative pull of the leading and lagging borse in a team, I would tell him that it depends on the way the doubletree is made and used. In the ordinary doublettee, the center hole for the pin is usually nearer the front while the holes for the singletree clevises are nearer the back. That is, the three holes are not in line, so when used this way the lagging horse gets a shortened end of the doubletree as it swings and therefore has no increasing share of the load to pull. Again the ordinary doubletree mustly has a D on the back side When the hitch is made in this, the reverse is true and the lagging horse has a decreasing share of the load because in this case the center fulceum is back of the sincletree fulcrums and as the doubsetree swings, it lengthens the lagging horse's end giving that

one a greater advantage. When the three holes or hitches are in line, neither borse gets any advantage when the displicate awares. This term ads me of another question I have often heard raised. Dom a load put principally on the front end of a wagon pull raisler.



LINKA LAEA

than if put principally on the rear? My own answer is that on a hard toad there is no collerence, but on soft dart or in the mud, the closer the load is to the team, the more they can pull, providing the batch is low enough to give a lift as well as a forward pull.—J H A., New London, Ohio

This Worsied Reader Wants A Crystal Iconoscope

Won't some bright reader of Popular Science Monthly please answer my question? Here it is is a crystal iconoscope possible? If the impulses coming through a crystal are sufficient to actuale the magnets of an earphone, why shouldn't a crystal sensitive to trievision impulses actuate the mannets of kibescope (receiver) for scanning and also make a cathode-ray beam? The chances are ten to one that I'm wrong but if somebody doesn't tell me if I'm right or wrong I'll die of curiosity.—F.L.G., Barmingham, Mich.

Model Worker Puts in Bid For a Modern Locomotive

I RECENTER had the good fortune to see a display of locomotive models made by Ernest Warther, of Dover, Otto There were sixteen in all, starting with the first attempt to make a railroad engine up to the present locomotives. One model was made of ebony ivory, and pearl. Others were of walnut, ivory, and pearl. All were connected to one motor through a series of belts. Now I would like a locomotive model, not one of course, with moving parts because that would require too much skill. As a sugges-

tron, I think a model of the Empire State Express would be nice. What do you other model workers think of this suggestion of time? J.W.D., Dolliver, In

We've Got 'Em on Out ListThe Pests That Should Be Missed

AN AMPLANE left here the other day with 200 pounds of serum to combat an epidemic of sleeping mckness among horses in Mary-

sand This gives me a bright what It horses get steeping suchness, who not other animals? Why can t science feed the germs to pests that ought to go to sleep? For incance, think of having tom-cats curied up asless instead of yowing on the back lence! Think of hav-



ing mosquitoes anoring instead of busy with heir braces and bits? Think of having house-flies deep in dreamless slumber instead of making tracks across the chinaware! There a mark for science to shoot at You can make your own fist of pests. And you probably will include nuts who write Our Readers' Say daffy letters like this, and that's oke with me —C R., Chicago, Ill.

See What He Means Or Do You Need More Light?

J.K.G. of Tallahassee, Fla., at least has oriental ideas concerning light, however they are not entirely correct. Light is a form of radiant energy traveling through the ether at a high rate of speed in the form of waves, it is believed. When a molecule has an excessive amount of energy things happen in side and some energy is radiated in the form of electromagnetic waves of various (requescies. When waves of a certain frequency strike the retain the sensation of light occurs. Now when, for instance, an electric light is turned on, the molecules of the filement get more energy, the filament becomes hot, and light waves are given uff. These waves strike the retina and the sensation of light is experienced. When the light is turned off, the filament ceases to rulate these waves and no more reach the retina with the result that the sensation of light is no longer apparent. The waves radiated by the filament during the time it was not do not disappear but continue to travel through the ether until they strike something which either reflects or absorbs them - M.H., Saint Paul. M.nn.

Try This Some Rainy Day When You're All Alone at Home

Marae you've heard the before, I just descovered R. Anyway, no kidding, there's a fown in Wales with the awe-inspiring name of Lianfairpwillgwagyllgogerychwynud-robwilliantymliogogogoch. It has a radroad station, and when the train conductor cals the stop be clips it to a proming "Lianfair." For fifty years this butchering of their town s

fair name has inked the proud Weish in habitants, and recently they decided to do something about it. They emblaconed the name in full on a banner twenty five feet long and hung it beside the station so that reaks at least could see what it reaks was, even if they



BUT I TELL YOU

never could pronounce it Fabry telling any one you were going there for the week end. There may be a longer name in the world somewhere, but I can't quite imagine it.—
E.F.K., Elmira, N. Y.



DO YOU WANT MOST IN YOUR NEXT CAR?

General Motors invites you to step out of the driver's seat and up to the engineer's desk—to tell us the kind of automobile you would build—the features you want most in your next car.

During the past year General Motors, through its Customer Research Staff, has invited well over 1,000,000 motorists "to pool their practical driving experience with the technical skill of General Motors Engineers and Production Experts."

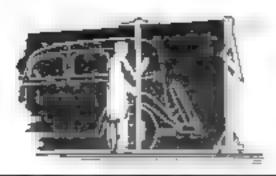
In case you have not received our questionnaire "The Proving Ground of Public Opinion," we shall be glad to mail you a copy. *

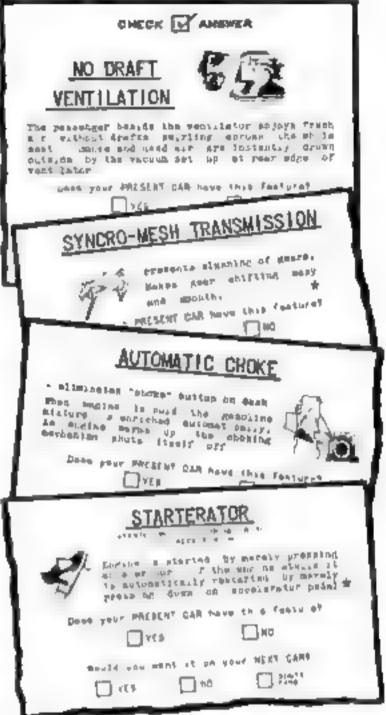
It contains 24 pages of interesting information on important automotive developments during the past five years, and gives you the opportunity to "cast your vote" on the future trend of design.

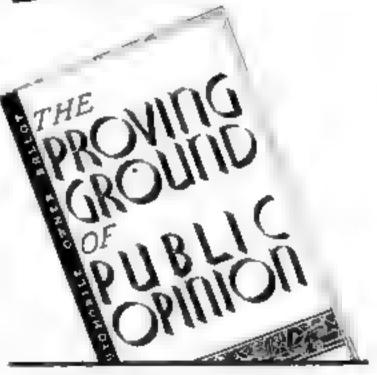
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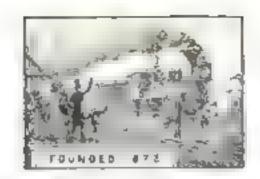
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*This booklet covers 67 features of motor car design relating to dependability, economy, performance, safety, comfort, convenience, appearance, etc — as per specimens illustrated above.



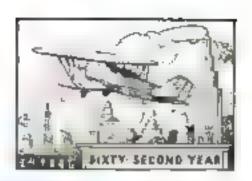
POPULAR SCIENCE

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RAYMOND J. BROWN, Editor



Doctors Face Death

Living Poisons



of MYSTERY DISEASES





By
STERLING
GLEASON

three courageous scientists are now in an isolated laboratory of the United laboratory of the United laboratory in the United laboratory of the United laboratory in the Un

the secret a dread disease, or succumb to a heroic death the fight and on many fronts.

s these masked experimenters work aboratories risking death dozens of handling germs and viruses. When buf-

flag diseases sweep the country in terrifying epidemics, they become leaders of a medical acroy, military in its stern efficiency and its demand that every member be ready to lay down his life for the cause

In this warfare, the latest scientific methods of the bacteriologist are weapons. Miniature epidemics, produced in the laboratory, rage for months while workers study symptoms and cures. Germs pass through countless generations in the test tube, live for years in the refrigerator while new races are bred and studied. Black-light nucroscopes are used to photo-





Mater all causing paintageaus, or parrules quested in whiched in this contriduce to apparate the sould matter on preparation for Elitering process

graph organisms so tiny that for years they have escaped detection

Such were the methods used in the study of other planues when the recent sleepingsickness epidemic broke out. It found medical science without specitic means of checking it, for alhough epidemic encephalitis, one of several forms of the dead-y eleeping sickness, has been known to man for 221 years, its germs have never been identified. It is one of a group of diseases caused by filterable viruses poisons containing either chemical substances of prodigious destructive potency. or else living organisms so minute that they pass through filters that hold back ordinary germs, and are provisible even under the most powerful microscopes

An alert pathologust detected the existence of encephalitis in St. Louis last July Authorities, on the watch for admitional cases, found an epidemic already in progress New patients were sent to isometion hospitals and in the merical world, virtual martial law was detailed.

of the U.S. Pabue Health Service arrived on the scene. At once he remitted a force of health officers, train investigators, physicians, nurses bacteriogists, and laboratory technicians. By long distance telephone he got authority from Washington to purchase mankers to be inoculated in the hope of developing a protective serum.

Meanwhile his medical army studied the history of every case and analyted sources of milk, water and food in a effort to find common avenues of mile tion. He was joined by Dr Charles L. L. Williams, Jr., noted authority on disease-bearing insects. The sickness was found

eleven times more prevalent in the suburbs. This fact led him to focus attention upon possible insect carriers, especially those with a proboscis like a hypodermic needle peculiarly fitted to plunge the virus directly into the bloodstream. These included the mosquito and certain biting fites.

Efforts to induce the disease in monkeys did not bring the hopedfor results. A human subject was needed. Without bestation, three scientists volunteered and submitted themselves to the stings of mosquitoes that had butten victims of the disease. As this is written scientists are antiously watching the outcome of this phase of the experiment

Meanwhile the epidemic serms to be abating. If it is checked on the St. Louis battlefront, expenmenters will take it into the labora-

So for an known, yellow

ferer is spread only by

this musquite sed only

the lemale will bite you

tory, where they will breed the deadly virus for further study. Here they will miect a gumea pig, rabbit, or mouse with the disease. Upon the animal's death, the brain and spinal cord will be removed, ground up, added to a salt solution, and injected into another animal to perpetuate the epidemic

Unlike ordinary germs, which can be raised in the incubator for many generations on a little beef broth, the virus ordinarily grows only in living tissue. So small are its organisms or active bodies that the microscope shows nothing of their nature. Dissolving infectious material in a test tube, bacteriologists pump

the cloudy solution through a Berkefeld filter—a candle of diatomaceous earth whose pores are so fine they hold back ordinary germs. They obtain a clear, colorless liquid which under the increscope seems devoid of life. Yet a single drop of this clear fluid has the power of transmitting the dis-

case to animals or men

Despite their clusiveness and the danger of contracting terrible diseases for which science has no cure, government research workers continue their attack upon the riddle of the virus. Even now in a secladed laboratory at Pasadena Calif., Dr V. M. Hoque and other workers of the U.S. Public Health Service are conducting experimen a with partial is a the involvence parent disease that rapidly that it is eased as one of the most highly

At the Hooper Foundation, the coverate of Canfornia's research laboratory of San Francisco, strollar studies are in progress, as well as at he Rockefe ler Institute for Medical Research in New York So has adout are they that Dr. Karl F. Meyer head of he Hooper homonous work involving york the birds—even

stanta firi wah

the soudy is a continuation of a courseous but he beaution in 1929,







when a mysterious epidemic flared across the nation. Simultaneously it sprang up in Paris and other parts of Europe. Symptom of the disease was a fever combined with a lung infection so similar to pneumotia that physicians found it difficult to distinguish it until death had claimed the victim.

Identification of the malady as the deadly parrot disease of the tropics come about purely through chance. An American doctor read about an opera troupe in Argentina, attacked by a strange disease after a performance in which parrots were used. Next day, he happened to notice a sick parrot in the homes of two patten a whose a liment be had not been able to diaghose. Scientists traced the malady at once to injected parrots and parrakerts recently imported from South America. Outbreak of the

disease in auxteen foreign countries signailed the appearance of a world-wide epi-

demic

War immediately was launched against the dread disease in five great laboratories. The highly contagious nature immediately appeared. Sick parrots, brought into the Public Health Service laboratory for study, caused an epidemic in which

eleven laboratory workers were stricken, one fatally.

DECEMBER, 1933

Though they worked in isolated, insect-tight, thoroughly disinfected taboratories, and wore stenlized masks and surgeons' rubber gloves, experimenters became infected with the malady. Infection came through the nose and throat, when workers breathed vieus-laden dust particles from the parrots and their cagesa form of exposure almost impossible to control. But these misfortaben, in the simple words of Surgeon-General Hugh S. Cumming, of the Public Health Service, "only served as an additional incentive to pur work."



This Berkefeld filter is so fine ordinary becturio can not pass

tations of parrols. France and a number of other countries imposed similar embargoes. Private owners, terrified, killed their parrots wholesale. The disease attracted wide publicmy when the wife of Senator Borah, of Idaho, contracted it. From their laboratories in Washington, government scientists directed her treatment by telegraph. Meanwhile, Dr. H. E. Haseltine and Dr. Charles Armstrong, distinguished scientists who were themselves recovering from a laboratory infection of psittacosts, gave their blood for a serum. An aurolane rusbed to Idaho with the precious fluid in time to aid her in a successful fight against the malady.

Once the movement of parrots had been checked by law the epidemic bursed itself out. It flared up again when California, a focal point of the disease, lifted its quarantine and permitted owners of avaries to ship their birds. Im-

mediately fifty new cases, due to Califorma-bred birds, were reported from all parts of the East. The Federal government thereupon permanently prohibited all interstate movement of the birds except under specific permission of state authorities.

Research for a remedy or immunizing serum is still going on throughout the

world. It has been found that chickens as well parrakeets, canaries, and love birds—may contract the disease

Still another deadly disease briked to a filterable virus is poliomyear is better known as infantile paralysis, a though persons of all ages may contract it. It leaves its victims crippled for life. Like psittacosis, it, too, is a mystery disease—another of the many sinister diseases that come to man in an unknown manner out of the vast disease reservoir of the animal kingdom.

When an epidemic of this terrible paralysis broke out in southern Cahfornia two years ago and began to spread northward through the state, accentists of the Hooper Foundation went into oction. Beatrice Howitt, research worker, aided by Dr. H. E. Thelander and Dr. Edmund Shaw, of the Children's Hospital, advertised widely for blood from persons who had recovered from the disease. Then she travelled over the state, collecting the blood, which she sterilized and pooled, five or six samples to a group.

This blood was then given to victims of the disease, fifty cubic centimeters at a time. Such blood contains natural anti-bodies which counteract the virus, and is the only known substance of value in the treatment of the paralysis. More than 140,000 cubic centimeters of the serum were used during another recent epidemic in New York, where 6,000 persons con-

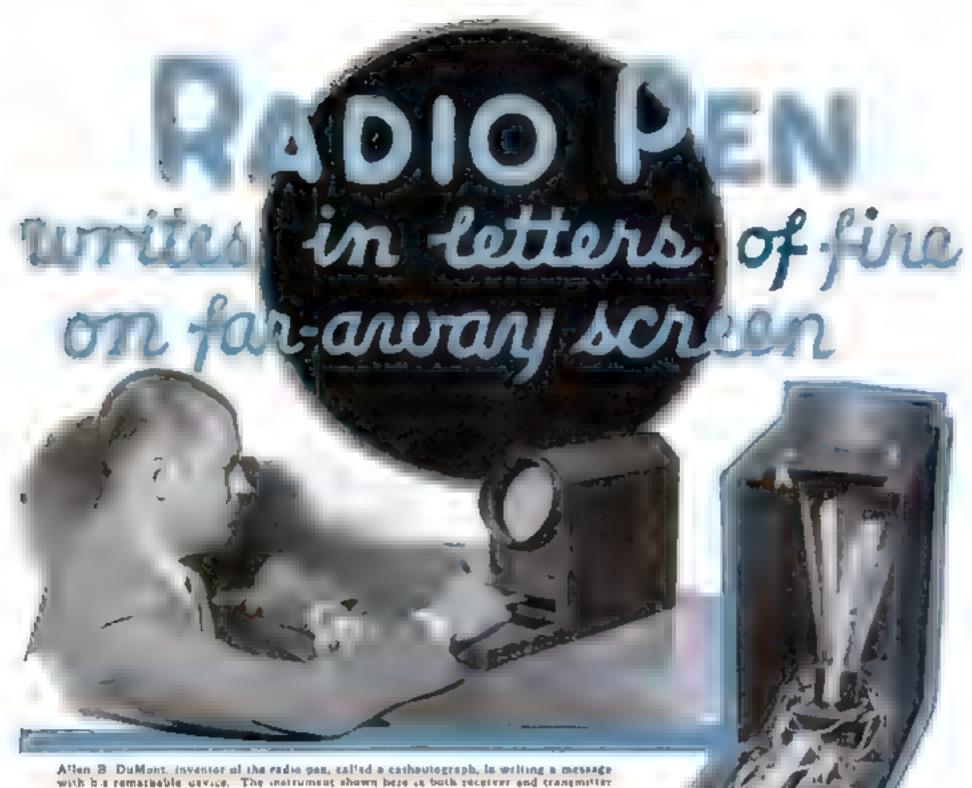
tracted the disease

When signs of an epidemic appeared in San Luis Obispo, Calif., the local health officer determined to prevent it from gaining a foothold in his city. Going from house to house, he and his workers visited every home, examining each person that was unwell. More than a hundred cases were discovered, many of them in a mild form that otherwise might have gone undetected until too late. Security was given immediately. As a result, there were no deaths, although elsewhere the disease took toll of many lives.

knowledge of the mysterious postomyelitus organism was recently advanced by Dr. Frederick Eberson, of San Francisco, who successfully grew the virus outside the body. The original virus, diluted a militan times, was transplanted to a new medium, where it grew and reproduced steadily. Apparently the virus bodies have a (Continued on page 102)

13





with his remarkable uswice. The instrument shown bere is both receiver and transmitter

WEEPING across a mysterious screen like an invisible pencia, a beam of electrons recently penned the message of welcome that opened the National Electrical and Radio Exposi-Lon in New York City

Seated before a small black box, Clarence L. Law, president of the New York Electrical Association, wrote his official greeting with a pencil-shaped stylus. Simultaneously, in a far corner of the exposition had, the words of his message flashed across a screen in glowing script As though guided by some unseen hand, a weird green spot traced out the luminous letters of fire just as they were written

This was the first public demonstration of the latest wonder of science—the cath-

ode-ray pen. (a co the "cathautograph" by its inventur, Aden B. DuMont, of Montclair, N J. this new instrument promises to add another important chapter to the story of communication. Sending messages that can be read rather than heard, it opens new fields for the telephone and the radio. Where earphones and loudspeakers bring code and speech, the cathautograph can bring the written word in any language.

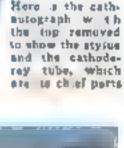
The fact that envone who can read and write can operate the cathautograph makes it particularly valuable in radio. In emergencies on the high seas, for instance ships equipped with electric pens would not need the constant services of trained operators for their radios The captain, the mate or even the cabin boy could acribble a message of distress and receive instructions

In other fields, the cathautograph meets simular needs. In air planes, it can be used to replace with its pencit-shaped stylus, the

present cumbersome earphones and microphones. Visual communication can be carried on between large transports and land stations and maps, as well as instructions can be sent and received.

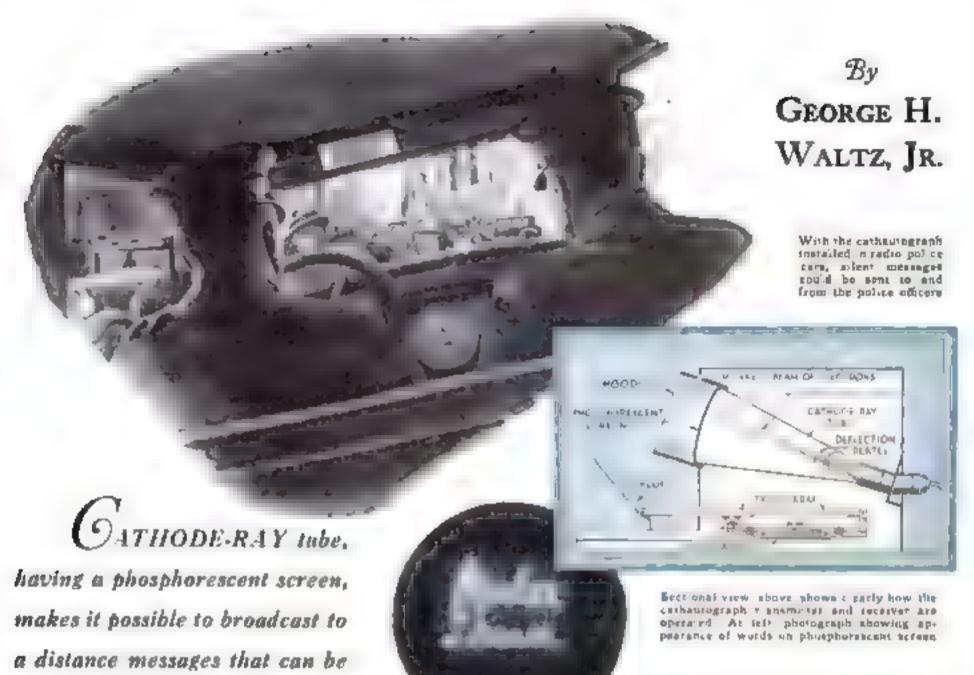
To the radio police, it offers a means of transmitting diagrams as well as written messages to outlying districts and speeding squad cars. In business, it can provide interoffice communication. To the stock broker it furnishes a quick, accurate means of sending and receiving stock. quotations and trading orders.

Physically, the cathautograph receiver is simply a special type of cathode-ray tube having a phosphorescent, instead of a fluorescent screen or tareet. Lake the kinescope of television (P.S.M., Sept. 33) p. 11), it depends on an easily deflected beam of invisible electrons. Speeding be-





Transmitting written market quotations is not of the uses to which carbautograph may be put



tween two sets of metal plates in the base of the tube, this beam can be bent up, down, or to either side merely by varying the voltage on the plates.

read as fast as written

At the transmitter, the pencil-shaped stylus is supported on a movable arm. By means of an ingenious sliding pivot, the arm and stylus can be moved in any direction to form even the most complicated letters and figures.

When the stylus is moved in writing a message, sliding contacts on the arm glide over two coiled wire resistances connected

In the broadcast studio, the cathautograpa can be used to give entertainer written directions

electrically to the two sets of deflecting plates in the tube of the cathautograph items arranged at right angles to each other, each resistance is controlled by the movements of the stylus, one by vertical motions, the other by the horizontal.

As each resistance is made shorter or longer depending on the position of the stylus, more or less electricity can pass to the corresponding deflection plates enclosing the beam of electrons in the tube. Since the deflection of the beam one way or the other depends on the voltage of these plates, its motion is identical with that of the stylus

Speeding through the neck of the tube, this beam then atrikes the special phosphorescent screen of the cathautograph. As the electrons in the beam bombard the screen, a glowing spot appears and as this moves it leaves a fiery trail of phosphorescent lines and letters.

In the present model some ten words can be seen on the screen before the glow of the first line begins to fade. As the eleventh word is written, the first word disappears and a new word can be written in its place. However, by aftering the design of the screen the inventor claims that it can be made to hold its glow even longer.

Inspecting one end of a simple two-way cathautograph system of the wired type, you would notice that the combined receiver and transmitter closely resemble a theatrical spotlight. At the top, mounted like the spotlight lens, you would find the

phosphorescent screen of the cathode-ray tube receiver. Below this, projecting forward, you would notice the writing stylus

and the movable arm.

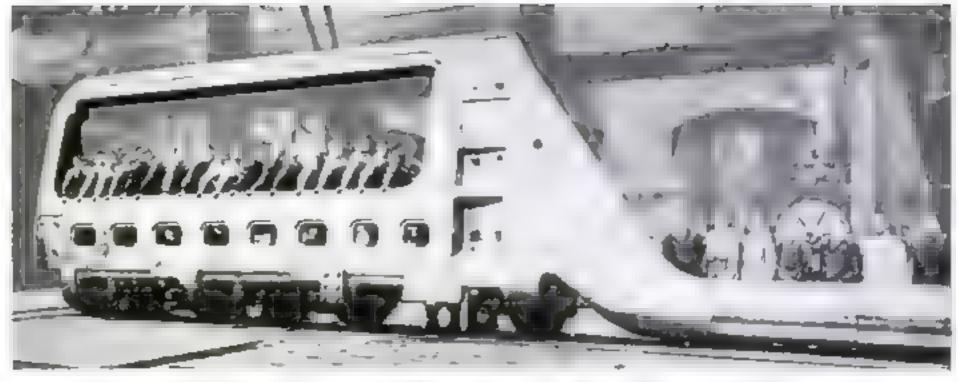
To write a message, you would instinctively pull the stylus toward you to place it in a normal writing position. This would operate an automatic call signal at the distant receiver. At the same time, a bruhant green spot would appear on your acreen and a similar spot also would glow on the acreen of the second instrument.

Using the stylus just as you would a pen or pencil, you would write the first word of your message. So free would be the motion of the stylus that you could write in your natural hand

Foliawing the movements of the stylus like a magic ball of fire, the green spot of light on the distant screen, as well as the one on your own, would trace out each letter just as it was formed. When you would lift your stylus at the end of each word, the glowing spot would disappear only to reappear again some distance away when the stylus was lowered at the beginning of another word.

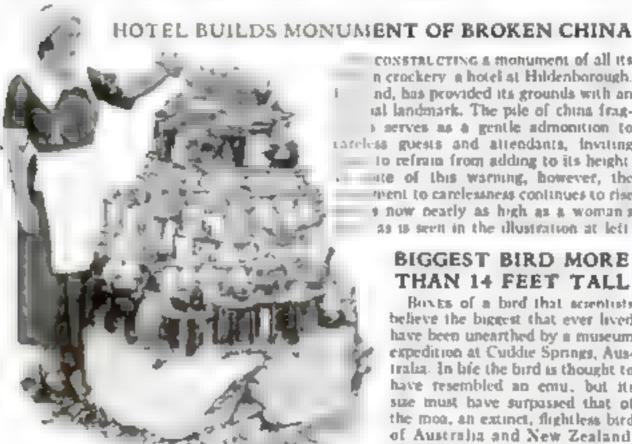
As the stylus at the other transmitter would be moved in penning the reply, the glowing spot on your screen would slowly and deliberately trace out letters, words, and sentences in glowing script. In time its luminous trail would fade and new words would appear. Finally, the script would stop and the red light on your receiver panel would go out, telling you that the message was finished.

The New York demonstration of the cathautograph marked the end of a long series of experiments, Now, its inventor is working on a method of making a permanent record of the luminous writing.



FIFTY-SIX-FOOT RUDDER FOR WORLD'S BIGGEST LINER.

It ar equipped with its mant rudder, the S. S. Normandte, biggest ocean liner in the world, is nearing completion in a French shippard for its maden voyage next spring Some idea of the veisel's staggering dimensions is given by this fitting alone, shown above, which measures fifty-sur feet in length and towers high above the workmen standing upon it. The view was made before the addition of sheathing that gives the rudder an unbroken, streamline surface. The mighty Normandia, first transatlantic vessel to be fully electrified (P.S.M., Oct. '33, p. 16) is powered by the four largest motors ever built



CONSTRUCTING a monument of all its

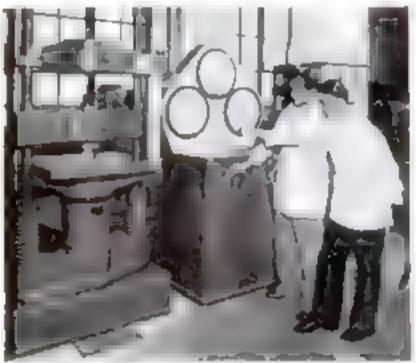
n crockery a hotel at Hildenborough. nd, has provided its grounds with an ial landmark. The pile of thing fragserves as a gentle admonition to careless guests and attendants, inviting to refrain from adding to its height te of this warning, however, the ment to carelessness continues to rise s now nearly as high as a woman s as its seen in the illustration at left

BIGGEST BIRD MORE THAN 14 FEET TALL

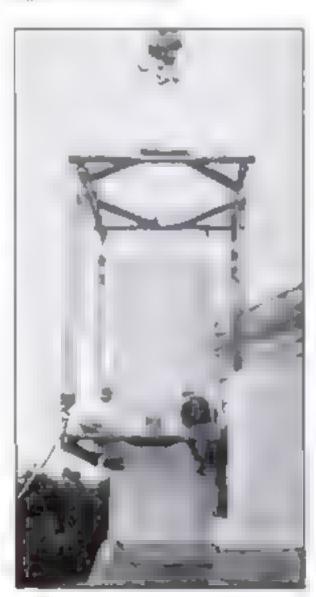
Boxes of a bird that accentists believe the biggest that ever lived have been unearthed by a museum expedition at Cuddle Springs, Austraka. In hie the bird is thought to have resembled an emu, but its size must have surpassed that of the mon, an extinct, flightless bird of Australia and New Zealand which stood fourteen feet high.

BIG MOUTH TESTS DENTAL FILLING

To LEARN how to make dental it lings so strong that they may be bitten upon without damage, samples of various materials are being compared to an unusual series of tests at the United States Bureau of Stand ards. The specimens are placed in a mechanical mouth that bites down upon them. Duals then register the pressure at which each one breaks. Results of the tests are being observed and carefully studied by experts of the Georgetown University Denial School.



Power machine gages pressure needed to break dental fillings



USE SWINGING SCAFFOLD TO SET MARBLE COLUMN

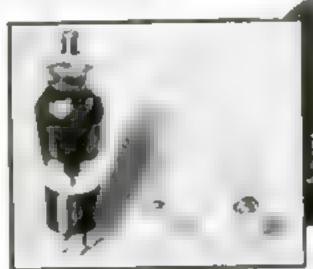
Serritvo marble columns in place is made. easier by an innovation in building methods, in which the workers and their scaffold are hoisted along with a section of stone that is to be added to the column When the section is lowered in place, the men are within easy reach of the joint, as shown in the photograph above. The new procedure saves the expense of constructing scaffolding around each column, since the small temporary scaffold is swung from one job to another,

Use Tiniest Radio Tubes in Ultra-Short Wave Study

Ranto tubes that look like toy marbles, beheved to be the smallest ever built, are aiding experiments designed to solve the problems of communication on ultra short waves. Their working parts are assembled in a space no larger than a pea, and a receiving set employing the new tubes fits comfortably in the paim of the hand. The tubes permit the reception of radio waves only a foot in length, thus opening a range of potential radio channels many times as wide as the regular broadcast band. Their develop-

ment by engineers of the RCA Radiotron Company is regarded as bringing nearer the commercial use of these channels, despite he fact that much experimental work on methods of transmitting ultra-short waves from the sending station to receivers still remains to be done. It is this work that the experimenters are now doing.

Al right treasmalter and freezewer used multra-short wave experiments. Below two of the tiny tubes for short wave use compared with a standard tube







THERMOSTAT FOR CARBURETOR

installed on any car, with only a wrench stid phiers for tools, a new thermostatic device automatically adjusts the carburetor mixture to suit the weather and the engine temperature. The thermostatic element, resting on the cahaust manifold, closes an air valve when the motor is cold and opens if making the mixture leaner, as the motor warms up

SNOWMOBILE FOR POLAR TRIP

MEMBERS of Rear Admiral Richard E. Byrd's second expedition to the Antarctic, which recently started for the South, will whit over the polar ice and show in a curious six-wheeled vehicle nicknamed the "snowmobile." Its endless treads provide firm traction, no matter how bad the going, while a pair of ski runners at the front serve to steer the car





a their airtight balloon gondola to reaking height of 11.8 miles above he earth the other day, three Russian necothe hack the first scientific observaever made at so great an altitude. their heads the sky provided a many speciacle; its color had turned to a soft, deep violet, almost devote of the light reflecting have found at lower levels. Looking down, they tried in vain to detect any curvature of the earth's hortzon. Following their successful wage to the stratosphere, in the gontails illustrated above, still higher ascents are planned.



Six-wheeled snowmob le to be used by Rear Admiral Byrd on his present expedition to the Antarctic

STATUE OF CHRIST THIRTY FEET TALL



tons, and a tower of steel has been erected on the site to support it. The design for the statue was copied from famous paintings.



BIG FLASH-LIGHT BULB FOR PHOTOGRAPHERS

To fill the need of amateur and professional photographent for an electric flash hulb of greater brilliancy than those previously on the market a new oversize bulb has been announced. Resembling a 300-watt incandescent hulb in size, it gives three and a half times as much light as the standard professional flash bulb with which it is compared above. Since a small-sized flash bulb designed for home use has also been placed on the market recently, a range of three sizes is now available.

SAFE DRUG TAKES OFF TWO POUNDS A WEEK

Discovery of a drug that enables overweight persons to reduce safely without exercise in reported to the American Medical Association by two California research workers. Experiments conducted by the discoverers, Dr W C Cutting and M L Thayer of the Stanford Medical Laboratones, show that daily doses of the drug will remove two pounds of weight a week



KILL SWORDFISH WITH NEW AIR GUN

Ht arting awordhab with an air gun is made possible by a weapon invented by C. R. Klein, of Santa Montea. Cabi Mounted on a boat with a swivel clamp it may be elevated or lowered and sighted in any direction. When a hand trigger is pressed, compressed air fires the harpoon and 200 yards of line from the small overand one-half inch barrel. A power compressor furnishes the 100-pound pressure.

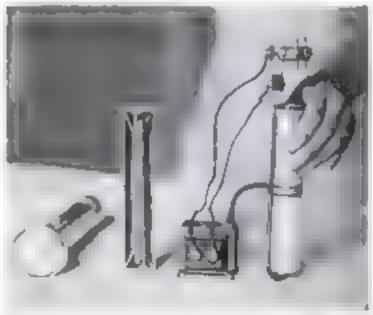
ble a few feet away. When filled with con-

crete, the figure will weigh peventy-five

of air needed to operate the device. The air gun weighs only eight pounds, is virtually noiseless, and is said to be extremely accurate in operation. The power of the gun is so great that the harpoon is driven into the fish at a considerable distance and the harpoon holds so securely, the fish is easily killed.

RECHARGE FLASH-LIGHT BATTERY

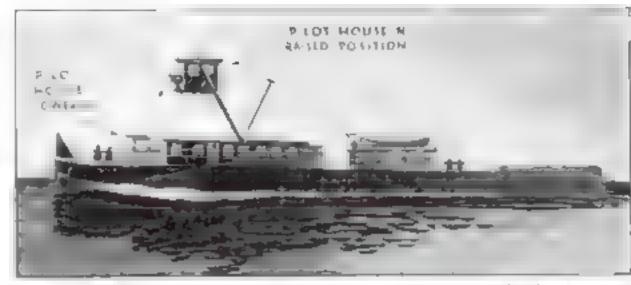
Firming any standard case a new type of flashlight battery may be recharged like a storage battery when it is used up, according to the Canadian inventor. Both the plates, and the moist jety that serves as electrolyte, are hermetically scaled within an inner container of flexible rubber, which provides for expansion due to gas, and an outer shell of aluminum. The flash-light battery will give ten hours of useful service after each charging.



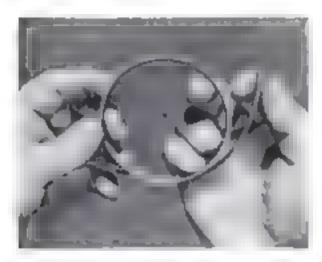
New rechargeable flash-light barrery right, and at left a cutaway view showing rubber container and aluminum shell

NEW TUG'S PILOT HOUSE CAN BE RAISED OR LOWERED

Equipped with a movable pilot bouse that can be hoisted to a height of twentytwo feet above the waterline, or lowered to the main deck, one of the strangest of towboats is being built for service on the Chicago River Its design gives the pilot the elevated point of vantage necessary for maneuvering a long string of barges, while providing for the fact that the vessel must pass under bridges where the clearance is only twelve feet. When a bridge is approached, cables will lower the past bouse and a motor-driven hoist will ruise it when the obstruction is massed. The 113-foot craft will be driven by a \$50-horsepower Diesel engine and will have three rudders. one in the usual position and one on each side of the propeller shaft



The illustration above shows the plot house on a new towheat related for observation purposes, while the detted lines indicate how it is toward to pass under low bridges



ASBESTOS PACKING NOW USED IN PISTON RINGS

Assestos paston rings, declared by their designer to reduce wear upon the cylinder was is of a car's motor, are the invention of an Eric. Pa., automotive engineer. Each ring is made from a U-shaped strip of steel or bronse, the groove being filled with asbestos packing as shown above. The latter is braided with fine copper wire and impregnated with graph to Rings of the new type are used as compression rings only

DELIVERY CAR LED FROM DOOR TO DOOR

JUST By R Wagon driver leads his horse, so the operator of a new British delivery truck can lead it from door to door. The threewheeled vehicle operates on storage balteries, and is ateered either from the driver's seat or from outside by means of a swivel bandle An auxiliary speed-regulat-ing handle just above the floorboard is also accessible from the exterior Thus the grocery man or baker may lead his machine beside him. stopping at each house on a block, and then step aboard and drive gway. The sixtyvolt battery that powers the vehicle will run it for therty to thirty five nules we hout being recharged, so that the truck is said to be very economical to operate and facilistates package delivery



FLOATING RAILROAD BRIDGE RISES DURING HIGH WATER

First of its kind in the world is a floating bridge constructed by daring engineers in French West Africa, to carry rathway and automobile traffic across the quarter-mile-wide lagoon separating Port Bouet from the mainland. The floating part, 639 feet rong, is built upon six steel pontoons, se-

curely anchored to concrete blocks sunk in the soft bottom. When the water is low the bridge is level. During flood periods, however, water ballast is admitted to the pontoons in varying amounts so as to give the bridge a camel-back curvature. Ingentous binges and ionots at the ends of the

floating section permit the passage of cars and trains without hindrance, regardless of the position of the bridge. By this plan, the engineers spanned the lagoon at less than half the cost of a fixed bridge, which would have been expensive to erect on suitable foundations.



Bridge spanning lagoon in West Africa. It is so built that during high water the center section rises without interrupting a affic

BIG ACCORDION WORKED WITH PEDALS

To proving musicians with a larger accordion than could be carried conveniently on a strap around the neck, a foot-

> pedal instrument of ingenious design has been deviser and patented by Samue Sater New York City in ventor One of its two ped als expands the hellows; the other contracts it. The pages are pressed with the fingers upon a keyboard resembling that of a piano. Removing the front casing, however reveals the each of the keys when depressed opens a valve that a lows are from the bellows to pass overcorresponding set of reeds for that particular tone kendily portable, the instrument is dismantled or set up ag in in a few minutes, the outer sections folding together to provide a case



FOLDING STEREOSCOPE FOR AIR-MAP STUDY

State AR in primarile to the old-fashience parlor stereoscope an avarion
is ere-iscope has been devised especially
for the use of air mapping companies.
When two pictures, made from near by
points in the air are placed side by side
and examined with this device as shown
above, the objects in the pictures appear
to have depth and stand out in relief
making it easy to locate desired landmarks. While the instrument handing
photographs as large as eight by ten
uches, it folds into a compact case

SPRING POWERS AUTO

AN At Toxical to be runs by clockwork was produced hereing by Janaiese designers. Its apring mater a said to drive the car forty miles at one who my Hecause of the amplicity of its construction he machine can be said at a fraction of the price of the average car.



Above sarge accommon attached to frame so I can be prayed with

perale Right front temosea to

eserted ayak one, quest work works

anatroment a ser valves and fords

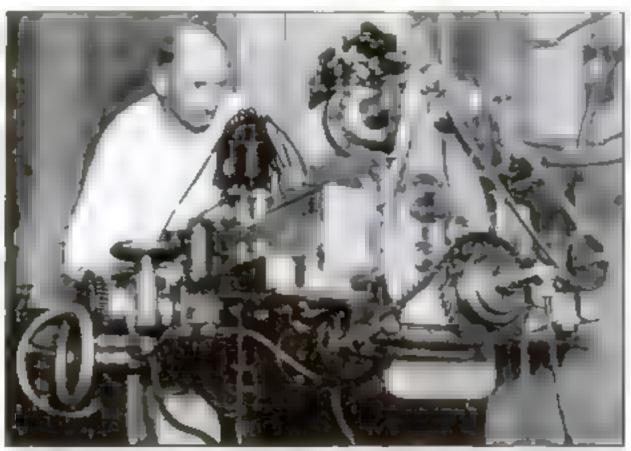
NEW TOOL PUTS WIRE BAND AROUND HOSE

APPLYING a wire band to a hose broken tool handle, or other object is a simple operation with the aid of a new tightening device. The wire, bent into the shape of a "L" with aquare base and long sides is wrapped around the object to be braced the ends passing through the loop. The tightener is placed with its notched end resting against the loop while the ends are twisted together over a pin in a movable bolt. The wire is tightened by turning a wing nut on the bolt. The tool is then swung over so the wire is bent to form two books around the loop.

MOTOR HAS 8 CYLINDERS. 16 PISTONS

INTENDED especially for motor cats and autplanes a gasol ne mator of radical new type has been invented by C. R. Klein of Santa Monica. Calif Testa of a 268 hotsepower eight-cylinder model, with sixteen pistons, are reported to show the motor unusually free of vibration and

economical of fuel. Two pistons in each of the cylinders operate from opposite ends and compress the charge toward the center, where it is fired. Klein now plans to build a similar monel of 1 100 horse power, which, according to the inventor, will be suitable for a large transport plane.



Modes of an eight-cy inder gasoline motor that has a steen pictons and develops 268 horsepower is being demonstrated by its inventor C R Rie n, of Santa Monica, Cal f.

Save Vanishing Totem Poles

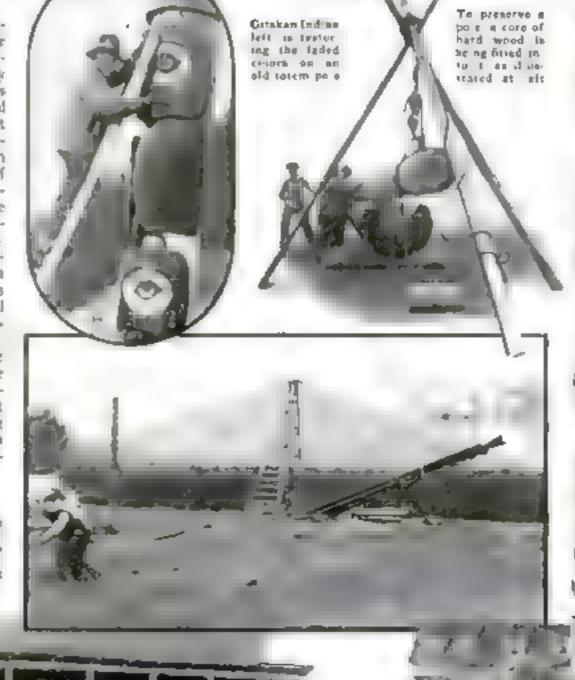


At left is a totam pole in the form of a mountain land, A government expect is at work restoring it near its original site at K rwangs. British Columbia. Below, a remarkable example of a highly curved to emple of a highly curved near Jasper. A borta

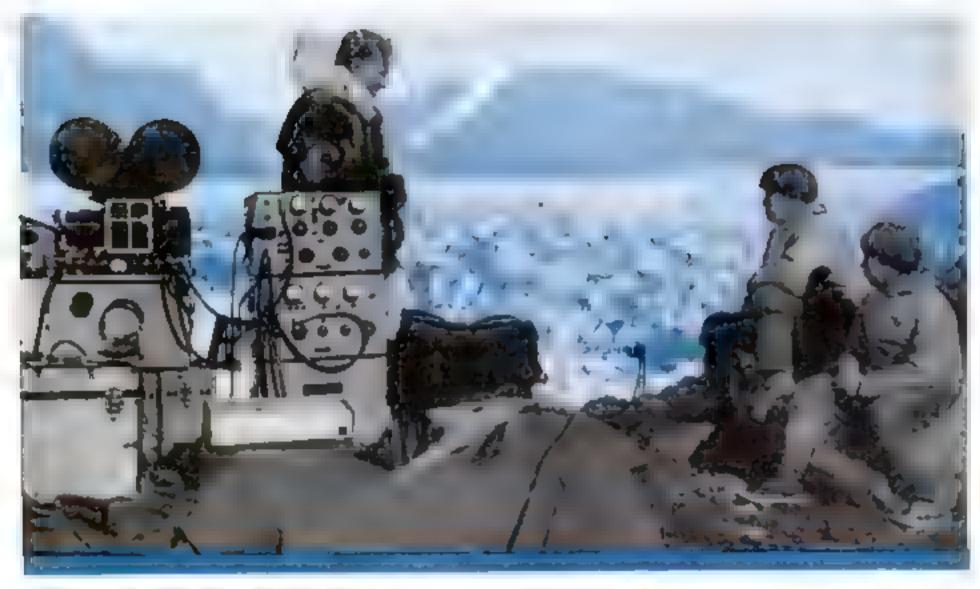
MREATENED with destruction by time and neglect, the last of North America's pecfuresque totem poles are being saved by government experts of the United States and Canada. Instead of being carted away to museums and parks in distant cities, they are being restored and preserved in their original settings in Indian villages of Alaska and the west coast of Canada. Carved in grotesque shapes depicting fantastic animals and birds, these emblems were originally erected by Indian tribes as symbols of their clans serving the purpose of aborganal coatsof-arms. Each pole was shaped from a single tree, and some towered as high as sixty feet. When the natives moved from their primitive homes to more modern dwellings, the poles were left behind The Indiana seldom troubled to fix a pole that fell down, its re-erection would have entailed as complicated a ceremonial rittal as its initial installation. When it become apparent that the few remaining examples of this ancient art would soon vanish, the governments of the two countries decided to try and save them

Each remaining pole is now being taken down and examined for signs of weakness or decay, and then restored to original form

After the totem pole is thoroughly repair ed. it is no sted to its erig nall poel-tion, as seen at right



At left a toters pole so decayed that its restoration was impossible was protected by a shelter huilt above it



On the edge of the Rink Clar er in northern Ores and, where cabergs are born. Cameran to record sound and more on are in place ready for use. Note microphone near center of photo

CRACKUP OF CRACKUP OF CRACKUP OF CRACKUP OF CRACKUP OF CRACKUP OF CRACKUP OF

caught for first time by SOUND CAMERA

FRCHID with our cameras and sound apparatus on a rocky eminence of a ford in northern Greenland, we looked down upon the great Rink glacier. cracking and greating on its way to the sea. Jagged white pinnacles of ice. sparkling with a million highlights in the sun, filled the gorge from wall to wall, a frozen river four miles wide. The sea came up the fiord to meet it. lapping at the base of the 400-foot precipice of ice that formed its visible luwer edge: below the water, the glacier extended

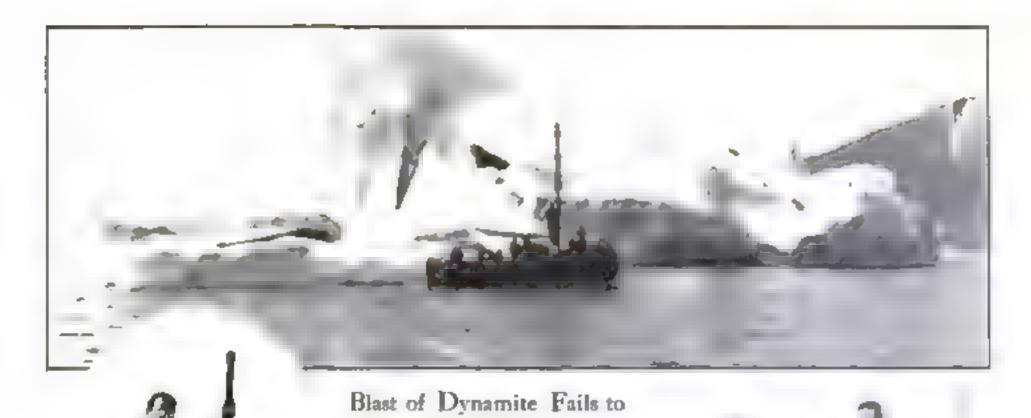
down into the Arctic depths 1,800 feet

Eventually, we knew, as the glacier pushed its way into deep water, its buoyancy would strain the advancing mass so forcefully that the whole face would crack off, be lifted bodily from its parent glacier and shatter into hundreds of mammoth feebergs. This is one of the two processal ways in which the nebergs that menace ocean shipping lanes are born, the other, less violent, is by the disintegration of floating polar ice

To obtain for the film "S.O.S. Iceberg" the first sound movies ever made of a glacier's crackup, we had traveled half way around the world and topped off the journey with a perilous boat trip up the ford among closely packed ice floes. Now, after a ten-day vigil at the scene, we knew the moment we awaited could not







Shatter This Big Berg

huir in ice for the dynamite

Consupers he cowere taken by a camera asked to the bow of a sayak

Vork City's Empire State Building, it plunged down and outward toward the sea. Ear splitting reports came one after another so rapidly that we could not distinuish them. The ground where we stood shook with the force of the acequake.

Though we were nearly half a mile from the glacier fine mist quickly drenched us. Rocks loosened by the terrific crash raced down the steep chif post us as we worked to record the cata-

cylum. When the last piece, as large as the national Capitol, bad thundered down, I had 1,000 precious feet of sound film.

Our escape was cut off. The icy avalanche had crushed our boats, and had so completely choked the ford with ice that no rescue craft could get through. We had rations enough for only three days. But waves sweeping down the fiord from the scene of the ice crash, ten feet high as they passed the base of our expedition at Nugaitsaik, fifty miles away, had told Dr. Arnold Fanck, leader of our experience, that the glacter had been "calving" and that we might need help.

On the second day after the crash we heard the welcome drone of a plane and Major Ernst Udet, crack German fiver with our expedition, flew overhead. I laid out panels requesting food, by pre-arranged



This is one of the most remarkable pictures made in the Aria's region. It shows the immersia iceberg, containing 10.000,000 tunk, slowly turning over Efforts to blast this berg lained but later it somethabled of its own accord

signals. Later in the day his tiny monoplane reappeared and he dropped provisions.

Two days later, with the aid of a pair of Alpinists who came to our assistance, we were able to reach the rescue boats by the land route, abandoning our camera equipment. Good luck enabled us to go back and salvage it the following week when an easterly wind broke up the ice jam in the fiord and sent the floes drifting

Our work was not yet done. We put out in our small boats from Nagaitsa k with one camera strapped to a two-place kavak for ready maneuverability, to get close-ups of individual icebergs wallowing, turning over, and breaking up in the sea, and of polar bears playing among them. These we secured near the coast, together with pictures of Major Udet landing on the water among the flocs.

Wanting she's of icebergs going to precent, I decided we could improve on nature by cracking them ourselves with dynamite We found however, that we could never tell what was going to happen. When two of our party boarded the first berg to drill it for a hast the entre face brittle with age, fell away without warning and dropped one of the men into the freezing water. Fortanately an Eskimo

in his kayak was near enough to save him

Not far offshore we spected another berg, a floating chunk possibly as large as a fifteen-story building, and weighing some 10,000 000 tons. Securing myself as best I could, I bored a raw of six-foot holes with my auger and charged them with 100 pounds of dynamite. The blast shook the countryside, a small block of ice flew off—and the berg merely shivered and resumed its lethargic pose

Then, three hours later, the berg came to life white we were staging another scene nearby showing Major Udet being rescued from a disabled plane by Eskimos in their knyaks. Without warning, the enormous iceberg rolled completely over in the sea. If the native stagehands had been a little slower in their rescue of Udet we might have had a fatal accident,

Girl Fights Octopus

FOR UNDERWATER MOVIE



DV VICING with easy, eras efal strokes a vocage of the fall of the movie camera. There is the fall strange to as er

of the deep—a hoge octorus whose frightful ten acres move slowly to and fro. Apparently unaware of the danger the swimmer comes within reach of one

of the slimy arms.

With this dramatic scene. Leon F Douglass, wealthy sportsman and inventor was trying out a new camera of his own design. His stage setting was an especially designed swimming pool on his estate of fifty-five acres at Menlo Park, Calif. The star of his exciting movie was his seventeen-year-old daughter, Florence. An expert swimmer she readily volunteered to do sham bathe with a twelve-foot octopus brought in a tank from Samonica Bay Haits. The huge creature seemed exhausted by its long trip and was supposed to have little fight left in it.

With the camera shutter clicking away everything started as planned. As the tentacles of the octopus encircled the dar-

This is the camera with which underwater pictures like Mand shown on this page, are taken. The tube on top of the camera in the part of the periocope through which operator looks to taking underwater views

and girl bowever it became apparent that something was wrong. The Indeous sea monster was showing unexpected life. Singous arms, studded with suction caps, wound themselves around the arms, legs, and body of the struggling swimmer Bubbles Boated to the surface, telling of the loss of air from her lungs as she fought to free herself blen who had been posted at the pool's edge, to give aid if needed dived to her rescue and fought to throw off the clinging coils that held the girl. Released at last, black-and-blue from her

encounter she cacaped to the surface.

by

The bottom of Douglass' pack is we with noul-brit and racket a natural-looking net-rig for many of the braisful pictures he has laken. Among hem is one of his a well a ughter, Ens, swimming beneath the surface with bits

of food tempting a send to fodew her Hin * 1 of vantage for the underwater scenes is a su merged window in the wall the pool, reached from the outside by mult tunned.

Devining improved camerax for photo-. opling submatine scenery is Douglass' hobby One of his inventions is a watertight camera fitted with a long periscope,

the photographer can lower the instrument from the surface and see through the tube of the periscope what he is t liming. Extra sections may be added to lengthen the periscope, which also serves have le to maneuver the camera

When the observer sees an exotic fish of a rare coral formation appear in the eyepsece, he tugs on a small chain that actuates the shutter mechanism and the scene is recorded. Another Douglass invention is a cone-shaped water glass six feet long, used to inspect the depths before lowering the camera.

These devices proved their worth in their first test last spring when Douglass accompanied the Johnson-Smithsonian Deep Sea Expedition, juintly sponsored by the Smithsonian Institution and Eldridge R. Johnson, of Philadelphia to record the wonders of tropical marine life off Puerto Rico. Now Douglass seeks to perfect a camera equipped with lights that will permit underwater photography at unhearded depths.

WORLD RANSACKED FOR SPECTROSCOPE PRISMS



New facts about health lamps are being discovered in a Cleveland, Ohio, laboratory by scientists armed with the largest spectroscope in the world. Behind the construction of this giant instrument lies a story that shows the lengths to which experimenters must go in obtaining the tools with which to work. When General Electric engineers set out

to design an instrument technically known as a "double monochromator," with which the intensity of any particular wave length of light could be measured with great precision, their plans called for prisms of crystalline quarts with faces four times as large as those commonly used. Ouarta was needed because it transmits uhra-violet rava with undiminished strength. When an order was placed with a German optical firm for wo triangular prisms, four inches high and six inches along the edges of the base, it was discovered that no single (nece of crystalline quarts large enough to make such a prism was known to exist! A world-wide search followed Finally, in Brazil, the needed crystals were found. Two gems of the optician a art were produced—a pair of prisms equalling in value a fair-sized house or a costly automobile. Mounted in the instrument, they enabled light from a lamp to be taken apart so that the desired color, or wave length, could be measured. Tests with the spectroscope will show how much ultra-violet light is needed to tan the skin.

At right in he intent the specific tention of the world. It is need to some some the two cast y prisons of the two cast y prisons of crystal line quarty used in the upoctroprops. Materalius these prisons was found only after a wide as a chief prisons was found only after a wide as a chief.



To put the voice of a coloratura soprano on the nit with fidelity, broadcasting engineers have devised a celluphane "bell" within which the smeet stands Covering her down to the waistline, the transparent envelop is said to do for the human voke what a mute does for a cornet or violin, and the singer can render her highest notes without feat of causing unnieasant vabrations in the microphone. The latter is placed outside the hell in the position shown in the photograph By this povel expedient, a problem that has builted broadcasters for years is believed to have been sulved, and the results are expected to become apparent in the improved quality of the voices that radio listeners wil. hear in their home sets. It is expected that experiments will show other uses for the reliophane bell



Toy furniture for children is easy to make with the aid of a jig-saw construction kit recently placed on the market. It contains sheets of wood that are stamped with patterns to be cut

out with a hand or power saw, as shown above, the pieces then being glued together Lis for toy soldiers are also supplied.

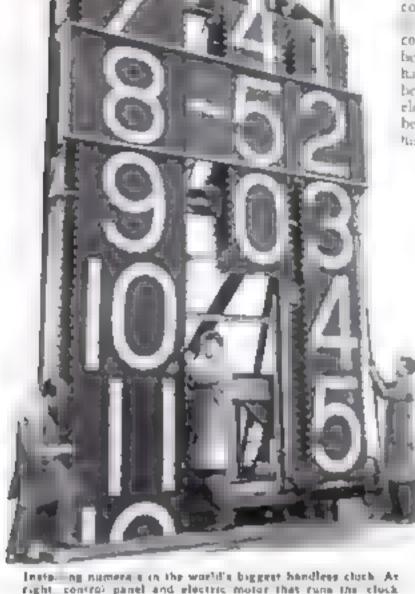


Voice of radio soprano, passing through callophane envelop to microphone, loses unpleasant vibrations

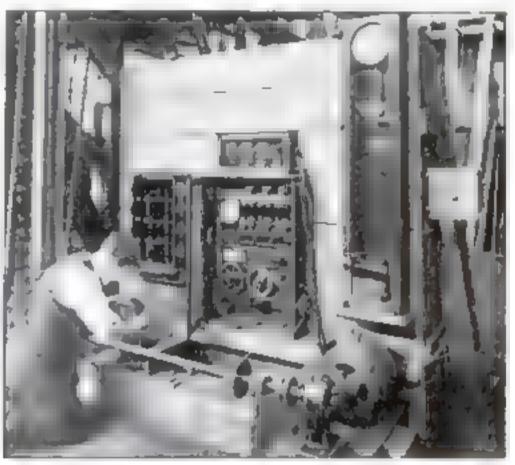
Monster Clock Has No Hands

high, will tell Londoners the time when a monster clock now under construction in one of this Britcity's railroad stations is completed. The hig timepiece is believed the largest without hands ever built. Three endless bests of steel slats, driven by an electric motor, carry the numbers past a rectangular window useb on the station wall where

Moving numerals, three feet they are made visible, Each numeral is outlined by silvered disks of reflecting material, and floodights play upon the ngures to make them show up clearly at a distance. The movement of the belts is governed automatically from a control panel with an extremely accurate master clock, which in turn is constantly regulated from the observatory at Greenwich. The steel roder on which the hour numcrais are shown is thirty-seven feet long and the blinds weigh about 15,000 pounds.



right control panel and electric motor that runs the clock



FORTY-POUND AUTO CARRIES SMALL PASSENGER

So TINE it could easily be mistaken for a toy, a therty-seven-inch gasoline automobile that really runs is the spare-time handswork of Paul S, Otto, sales manager of an Iowa City, Iowa, advertising firm His three year-old son is the chauteur Dimensions of the insiget car seem to bear out throw benefithat it is the smallest passenger-carrying machine ever built. It has a wheelbase of only twenty-live inches and weighs forty pounds. Despite its small size, it easily carries its voutbful driver at twenty trules an hour. The car required 2 000 hours to build. Its two-cylinder motor, according to Otto, looks and works exactly like big ones, and is complete with three-jet carbonetor miniature spark

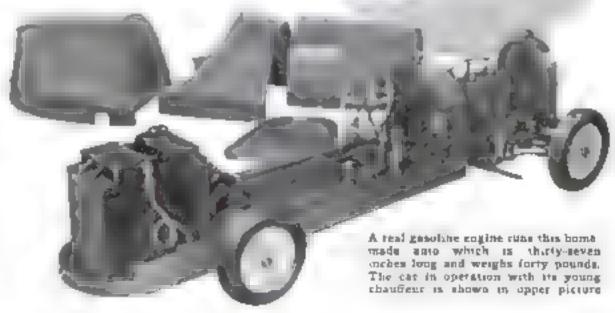
plusts, distributor, muffler, water pump, radiator, fun, clutch, and gearsh ft



FLASH-LIGHT BATTERIES WORK FOREST PHONE

OPERATING on flash-right batteries, a new type of field telephone has been developed especially for use by forest-fire fighters and has been tried out successfully in tests near Vancouver, Wash. The aluminum case weighs less than four pounds and contains three dry cells, with a condenser and other necessary electrical accessories As soon as the two wires shown in the photograph above are booked up to the line, the phone is ready for action. Formerly it was necessary to carry beavy butteries and cumbersome equipment over difficult trails to set up communication.





America's Oldest Road Roller Found



Olumn American tend to let, used by Mayane, was therean long and weighed about five tons

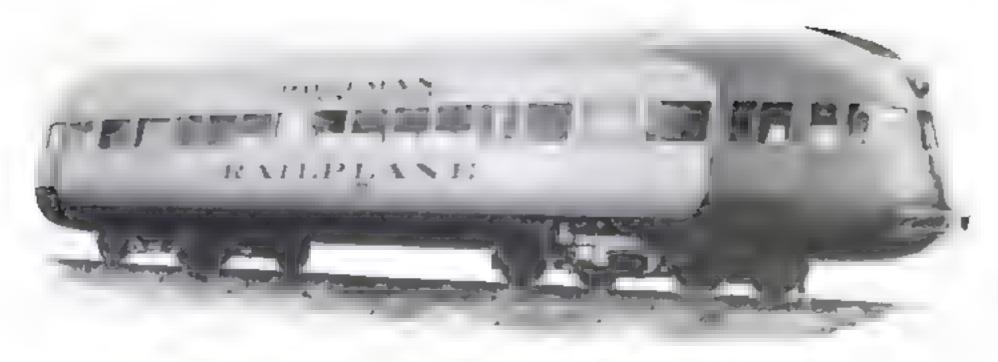
Federal Official Builds and Sells Model Locomotives



Mayor had no beasts of her ten acwhere ed vehicles. The ancient has bfirst dug down to hardpan and erected re-

Albert P Clow. Washington, D C. building a model locomotive in his work-abop. He is a Federal offic at bur he gats profit and fun from his hobby

Pro fit as well as pleasure is derived from his helicy by Armit & Clear special investigator and attorney with the Inters are Commerce Commission at Washington D. C. His space time hours are occuraed in harding miniature ocomptives that run ander their own power Orders for his engines come from refred engineers of leading transportation systems, who desire faithful copies of their favorite engines as mementos of their days behind the throttle. So far Clow has constructed fourteen of these models, selong them at prices ranging from \$150 to \$300 apiece. The engines burn either coke or soft-coal siftings on here tiny grates, and can develop as much as cupity pounds' pressure of steam. They travel at speeds up to fifteen miles an hour on suitable track. The largest foremotive Clow has built will easily haul a load of 300 pounds. Atways interested in model locomotives, Clow spends eigh, it ten hauts a week in his basement workshop which is inexpensively but adequately equipped with a loot-operated lathe and homemade milling attachment, a stout work bench, a bench drill, a vise, and a complete outfit of hand tools for both wood and metal work. Hundreds of pactures of locomotives cover all parts of the walls often asding in solving problems of design. It takes Clow from nine to ten months to design and build a locomotive model, like the one complete in every detail that is shown at the left, which may contain as many as 3 000 parts



AIRPLANELIKE RAIL CAR HITS NINETY-MILE SPEED

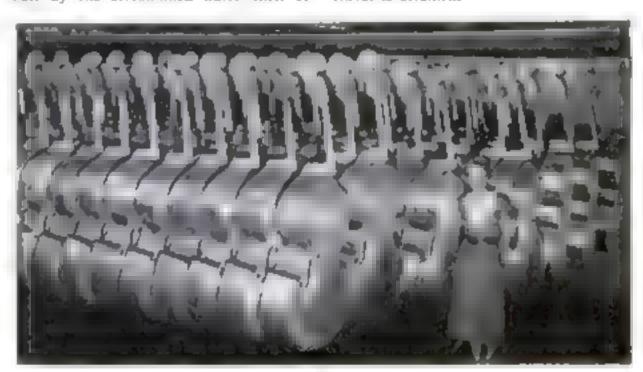
Aim nare architecture is adapted for rai was use in a new vehicle known as rail; and and designed for high-speed interpretar service. The new cas was tested successfully at Chicago the other

day Seating fifty persons and driven by duralumin that en two internal combustion memors on the front truck, the car can attain finely miles an hour. Wind resistance is cut in half by the streamlined outer shell of travel is attained.

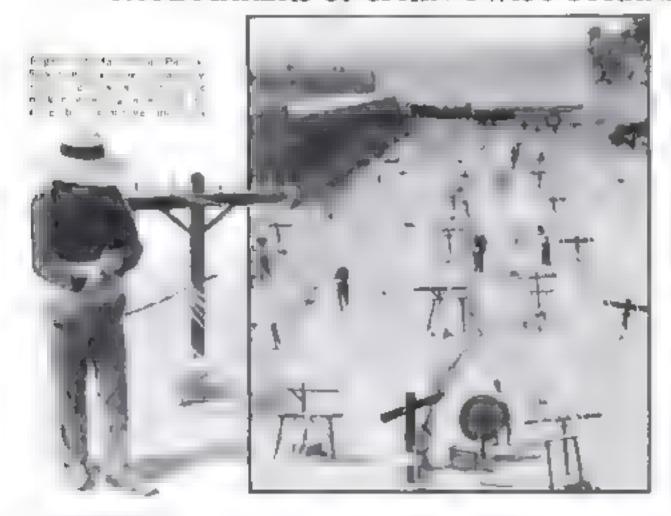
duralumin that encircles the new car, reducing the waste of power from this cause by fifty percent. As a result the sensation and nearly the speed of air tentral is attained.

ALUMINUM BASS VIOLS USED IN ORCHESTRAS

DECLARED to possess a tonal quality that compares favorably with wood instruments, aluminum bass viols are gainink in popularity among musicians of dance and symphony orchestras because they are impervious to mousture. The unusual picture reproduced at right shows more than a hundred of the instruments at the Buffalo, N. Y., factory where they are made. In the process, light scrong sections of aluminum alloy are rigidly weided together without the use of screws or rivets. In haishing them they are given a natural aluminum, gold bronze or imitation wood appearance. The derogner says mucy other stronged instruments can also be given a satisfactory tone.



ROPE MAKERS OF SPAIN TWIST STRANDS BY HAND



In support the telegraph point half-covered by sand, native tope makers of Paima, Spain, ply their ancient craft. Actually the telegraph poies are frames that support the hemp yarn as it is spun. To to this one man fastens a bundle of hemp liber around his want, attaches one end to a hand wheel, and slowly walks away paying out the varn with his hands. Meanwhile an assistant turns the wheel to wist the varn into a compact strand. When several such strands have been spun, these in turn are twisted tigether to form a rope.

DEADLY ANTISEPTIC NOT INJURIOUS TO HUMANS

A BIG BERTHA in the war on microbes has just been developed by cooperating scientists of Western Reserve University, in Ohio, and the University of Iowa in lowa. It is a new antiseptic said to be 1,000 times more powerful than carbolic acid, yet harmless to man even if taken internally. The new product, soon to be placed on the market is the result of seven years of research.

THREE AMERICAN

Chinchilla Farms

PRODUCE MOST COSTLY FURS



Plant, employer Without P. Centre lad

make one large coat like the one plustrated at the extreme right.

Yet these are the only known thinchilas in the world that are reproducing in captivity. In warm California weather and the colder winters of the northwest, they continue to thrive, six years after M. F. Chapman brought them from the Andes In that time, they have increased more than thirteen fold despite losses from theft and disease.

Today the three herds at Idaho Falls. Idaho, Logan, Utah, and Inglewood, Cal : are worth a king's ransom. Single pairs for breeding bave sold as high as \$1,000 One coat made up of 140 pelts has brought \$45,000. Single skins in New York and Los Angeles sell for \$200 to \$300. Smugglers occasionally offer pelts in the world's fur capitals, since neither live animal nor pelt may be legally at

Charchilla fur in care, beautiful. It once was worn only by monarchs and their queens, but the passing of monarchies and their fabiliously wealthy rourts has made the fur available to others. Not more than a dozen chinchilla coats exist in any American city; possibly not over a hundred in the world

One naturally thinks of Russian sable when discussing care furs. The great value of that for comes not so much from its beauty as from the deliculty of trapping and matching the sables. Often two or three years is required to find a sufficient number of sable pelts to make one coat Not sale es connot be reared in captions while chinches as reproduce as well in American pens as in the Andes 16,000 teet above sea level.

They live their new lives in spacious

stalls measuring six by sixteen feet; one male and six females to each stall, From two litters a year in the wild, they have increased in many instances to three in captivity, the average of two young in each litter remaining the same.

"There are fewer chinchina sales than sables." I was told by H. W. Blaine, a veleran for expert but we account for that argely by its scarcity. There probably are not more than three churchilla coats in America made up ready for sale Whenever a furrier receives an inquiry for a chinchilia coat, he scours the coun-



Wild Creatures from South American Andes Thrive in Captivity and Make Their Owner a Fortune in the Mountainous Sections of Our Western States



In recesses made in their pene, the chin-

try for pelts, buying them in lots of from three to a dusen. When he pieces them together they achieve a value of from \$15,000 to \$45,000, depending upon the number and quarty of pelts."

Ermine, one of the most beautiful furs white and hase for, caracul are all found in women's wardrobes, yet chinchilla remains the most desired and least attamable fur in the world. Dyed rabbit at operation his of the cost often is offered as a substitute, but an expert can tell a rabbit cost from a chinch lia at a distance of 100 feet,

Chinchilas are rabbit-like in appearance, though much smaller than the average rabbit. Lattle larger than a man's hand, they live among the Abdean tooks. In captivity they spend much of their time in cavelike recesses of their pens. In the open, their protective coloring enables them to blend among the rocks and they can bardly be seen when on the run.

They emerge at dawn and at dusk to feed, eating the same vegetables and grains a domesticated chicken consumes, By
Andrew R.
Boone

M. P. Chapman, who was first successful in raising th ach I'm in capt v. ty. finds them friendly creatures as this photo shows. At top, Chapman's pen in which he keeps seed of the sittle animals.

though hardly as much. Chapman says his feed bill averages not more than \$1.80 a year per animal. They are subject in captivity to no more discuses than are American rabbits, and, when one dies, an autopsy usually reveals little balls of hair in the stomach. The chinchillas lick themselves and the long hairs pass with food into the stomach, where they remain undigested.

There are two commonly known species, although Chapman has bad as many as five species growing together. Gradually four disappeared until he now has only the Chinchilla langers, found chiefly in the mountains of central and northern Chile. The skin is finer than that of other species and its color is a smoky gray with black markings, with the under parts a dead gray with a yellowish tinge.

As I held a fine male, stroking its long hairs. I realized why these rodents have been hunted since the remotest ages. Once the Incas wove warm cloth from their hairs, even domesticated them and ate the flesh after shearing the fleece. Though they have been known in South America for centuries, not until the turn of the century did any reach western markets. Immediately furriers became intensely interested and following the importation of a few skins to Paris, world-wide efforts began to bring chinchilla coals to wealthy men and women

Vet Chapman is the only white man who has succeeded in raising them—and he has his difficulties. Someone recognized

the tremendous value of the Chapman herd and in the dead of night stole into his mountain canch at Tehachepi, Calif, (recently abandaned) and made away with thirty-five sturdy chinchillas Sixteen were carrying young. The potential loss, therefore, amounted to fully seventy of the maimals. Chapman, in awearing out warrants for the unknown culprats' arrest, placed a value of \$54,000 on the stolen at the a

Lare last fall eighteen were traced to a ship bound for Germany. So closely did United States operatives press the hunt that they learned five died en route. Later one American confessed his part in the theft and today is paying the penalty in San Quentin prison. Two of those amuggled to Germany are alive today, he the others having perished. The other seventeen have not been traced.

Chapman's chinch la exploit is packed with drama. Formerly a mining engineer, he went to South America nine years ago for a mining syndicate. He made his head-quarters high in the Andes of Chile and Peru and white living among the native Indians and Chileans became interested in the chinchillas. He had heard great tales of their former high position in the international fur trade. One man had exported 100,000 skins from Chile in 1884. In 1901 fully 1,000,000 skins were exported from that country

San Pedro de Altacama was the most important local South American market then. From (Continued on page 203)

DICK BOWMAN, Pioneer

Flies Down Radio Beam



mission granted to fly over the top to Burbank Over the top! Under a star-studded canopy of blue over a bill owing white floor. The world was hidden from view, but the voice of radio and the dots and dashes of the radio beam, told me constantly that I was flying on course, riding behind roaring motors to the brilliant lights

where, as we say, he got fresh weather

"Burbank to Bowman," came the reply instantly

I wasted hardly fifteen seconds before I heard Ables' sepulchral voice as it hurdled the mountains, penetrated the fog, leaped into my ears. In those few moments be had left his warm office and walked out onto the field

Burbank answering Bowman," the voice said. "Per-

One of the serials that are mod in sending out directions by radio to plate in an effort to guide them through for to a safe lending

"Just a minute."

Transport Pilot, Tells How He

Through a Mile of Fog

that in an bour would guide me undeviating!

Flying over the top with passengers at night who and mountains are bathed in fog or washed by no longer holds terror for phots or passengers carry them through the stuff or over it unles we is absolutely what hes shead, behind, below, and we --

I started climbing when Ables told me to come -I knew we'd need 13,000 feet to get over forty-mile stretch of mountains that marks the separating southern California from the great Sin J. valley. Ten minutes later, we left the moon of everything with not even a land mark in view (22me along the invisible route

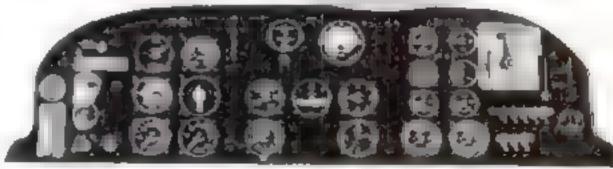
Pilots no longer need to navigate by following comof the earth, by leaping goal-like from mountain mountain-top. During clear weather, after long the we follow the compass and a sort of sixth serfrom port to port. At might, we grow to know the

clusters that dot the surface of the earth wh or Village tleeps. But day or night, we need only tune to the beam frequency and signals from one of Uncle Sams radio beam stations will drone in our cars and bold us to our course

Usualty it is comparatively sample to find the beam, as I did this night. I was flying slightly off course to take advantage of a stronger tail wind when Ables gave me the okey. Knowing I had awang of eastward, I turned the ship in toward the invisible path. In a couple of minutes amiliar agnals began to flow through my phones.

I banked and headed into the beam. moving gradually toward the right until I had entered the "on course sector





Nece are the many netruments found on the modon plant Every move made by the prof in tea orded so he always knows what his plane is doing



board shows two white subtaining reeds

when the pilot is on the light course

DIRECTOR OM GROUND AIDS PILOT

With a phone at author car. the man on the ground keeps to touch with the pilot and guides him safely down in spite of a mile-thick blanket of deagerous fog where the steady drumming of dasher told me I was headed directly toward the radio towers nearly eighty miles away.

Sametimes summer storms build up over the airways to considerable beights On my own run. United Air Lines from Nan Diego to Oakland on the Seattle-San Diego airway, we may climb to 18,000 feet to escape them. A ways, as on the night in question, we report our position every twenty minutes, either basing our estimate on some visible landmark, or, if all identifying peaks are obscured, on an estimate of our speed and drift from the last seen point or radio beacon

Soon after I had begun to fly over the thick stuff, answering a position request from Burbank, I spoke again into the mike, that the ground crew might keep

"Bowman in Marin," I said. "On Saugus beam Estimated position over Lebec thirteen thousand solid overcast below temperature thirty-two."

Freezing temperature, but ice cannot form unless sufficient moisture collects on the wings. And ice cannot collect when we fly in the dry air above moisture-filted fog and clouds So we roared ahead through the night passengers warm in the heated cabin, blue flames trailing the engines as we pushed across the mountains.





I had not inquired about the weather at Burbank. This caused no concern, even though I knew we probably would have to come down through the log before landing. When Ables gave me the "okey that told me conditions on the ground at my destination were satisfactory

Ten minutes later, the radio signals suddenly censed. We were passing over the "cone of silence."

"Bowman to Buroank." I called, "Pass-

mg Saugua field."

The cone of allence is a fan-tike empty" space between the two beams coming from this lonely mountain station. For nearly a half-minute only the crackie of static reached my cars. Then, as though an operator had come suddenly to life, the signals again came in, strong and reassuring

On course we continued, hearly three miles above the earth almost two mans above the jagged peaks below, until at last the intermittent crackling of a second kind of heacon fluoded the receiver. Dot det dot dash dot. Twelve seconds elapsed. During this period the steady hum of the Burbank range held us true to course

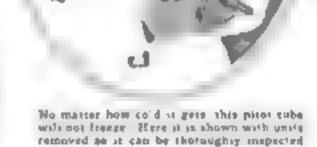
The periodic flashes told me we were approaching and passing over a marker beacon, one of seventy-four intermediate already facilities in operation on the Federal Airways system. But it told me more; we were now eleven minutes from Burbank, within gliding distance of the field, although we still were flying at .3 000 feet, with no vision of the earth

to guide us.

For five minutes us we roared 150 m lesan hour southward, the dots and dashes from the marker broke in on the hum of the range until at last they died out and vanished in the distance. I could have talked with the operator had there been any necessity for doing so, but all was well and soon we were to land.

Hardly had we flown through this shaft of sound then activity revived on the ground. Though he had kept a constant lookout for changing weather conditions I knew that by now Ables had talked with the government weather men. They al ways compare notes before the ground man gives me the final word, for by now we were no further than five minutes from the field. I held the phones tighter to my ears, waiting for the call that would come any second. Here it was!

'Burbank to Bowman," came the message. "Weather at Burbank ceiling



between 900 and 1,000 feet and ragged . . visibility to porth about five miles . . . tops of mountains east of field topped in fog . . . Hellywood incuntains topped in fog . . . Santa Monica mountains topped in fog . , . can see lights of Hollywood (six miles away) . . wind south seven."

As he spoke, Ables was giving me a picture of exactly what he knew I would see a few minutes later. The lower edge of the clouds was ragged. I might break through at a thousand feet or 1,200 feet or 900 feet. He was playing safe so I wouldn't be disappointed in case my altimeter showed 1 000 feet and I could not vet see the lights below

Now the responsibility shifted, odd as that statement may seem. True, I am the pilot. I flew the ship. But it was up to the ground man to guide me down in my circling path. As I came nearer the field. I glided down toward the roof levening off when we were still 500 feet above the for



Londing lights like this one are set within the wing. The molded glass covering over the light is shaped so it is part of the wing

From his station on ground the operator hings pin togio anne tà un out que e le tphone number. Then he can tak directly to the priot of a plane above the airport



I listened intently, for soon the plane would be flying under direction from the ground. I sat with my eyes fixed on my instruments, twenty-one of which fill the instrument boards of the newer planes. I computed hurriedly from his observations the thickness of the fog. Altitude 7,000 feet, 900 foot ceiling below. Subtract 900 and 500 from seven thousand. That leaves 5,000 feet, a whole mile of for-straight down!

Burbank to Bowman," the voice spoke "We can hear your motors northwest of the field. You are on course. What is

your altitude3"

Bowman to Burbank . . "Now you are northwest of field . . . bump your motors three times.

I jazzed the gun three times for identification.

"Blimp your motors once more

Apparently the wind had carried nucnoise away and the ground man, to make absolutely sare of his identification, to avoid sending me down elsewhere in case a strange plane had come sating in, ordered me to speed up the engines again. So I jazzed them the second time "Okey, Dick." he said. "You are right

over the center of the first in position to

come through."

I had prenty of confidence in Ables' observations and instructions. He was a nilot dunng war-time. I knew that he knew a 900-foot ceiling when he saw one I felt right at home. While I was about to fura to my instruments for circling down a mile, I knew the sound of my engines would keep me located in Jae's mind. I knew, too, that he would not become confused as he turned in a circle following me. For at his elbow is a compass board, on which the several compass bearings are laid out. If he bears me on one side, he need only glance at the board and read the direct or

And so I replied in short order, "I'm

coming through

I have heard it requires some sort of sexth sense, some particular form of daring, to fly down through thick stuff at might, when all we can see are wisps of log dashing by the windows. But it is neither thrilling (Continued on page 104)



OON to rise upon Mount Locke in son hwestern Texas, the great McDonald Observatory will tepresent the most modern achievement of the astronomical designer's skill. Plans just announced for its construction by Warner & Swasey Co., telescope builders of Cleverand, Ohio, for the joint use of the University of Texas and the University of Chicago, reveal that its monster eighty-inch reflecting telescope will be second in size only to the great 100-inch reflector at Mount Wilson, in California. Both the telescope and the observatory built around it will incorporate ti tra-modern aids to astronomical research.

The telescope proper, a massive open framework of metal twenty-six feet long, supports the eighty-inch mirror at its lower end. This four-ton disk is to be cast of a standard make of heat-resisting glass, found in recent tests to be superior

to optical glass for the purpose because of its lack of sensitivity to temperature changes. Its granding and potishing will be a delicate, two-year task. When it is in place, the great marror will collect light from the stars and bring it to a focus with the aid of supplementary mirrors. How these may be interchanged to permit visual observation, photographs, and the use of special instruments at many places, is shown in the accompanying illustration.

A hemispherical dome, scaty feet in diameter, weighing 115 tons, houses the big telescope. Despite its great weight, electric motors turn it easily upon roller bearings so the telescope may be trained in any direction through the fifteen-foot slit that extends from the base of the dome to its zenith. To guard the telescope from the weather, sliding metal shuttern cover the aperture when it is not in use; and when the slit is open, a canvas curtain may be raised to prevent

wand from shaking it. Electricity automatically turns the telescope to follow the stars.

To enable an observer to reach the appermost of the numerous points of vantage, an electric elevator, controded by push buttons, carries him aloft along the circular gisders of the dome. At the lower end, two movable platforms, electrically operated, rise or fall at the will of the observer. Another refinement is a spectrograph room in which the air may be maintained at a constant temperature, when this is required for extremely definate observations. The wiring system is unique of its kind and contains four miles of electric wire.

Observing faint stars, distant nebulae and galaxies, and the spectra of stars will be the principal tasks of the new observatory. With the benefit of the most modern apparatus, its staff will be able to photograph stars a milion times fainter than the unaided eye can see.



HOW TO CHECK UP ON By Gaylord Johnson

On a curved map of the United States piece sunding on the hourly mend and. Let a amp be a acting on the sub. there directly on the 75th mendian, at which point at a then soon. Move the map from west to east and you will see noon awast west fired degrees each hour. This experiment shows the basis of our Standard Time.

IME and the

STRONOMY is not merely a postime for stargoning scientists. Instead, it is one of the most practical tools that man has made for himself and one that has aided human progress as much as have chemistry and engineering.

Without astronomy, ocean voyages would be so perilous the world would yet be largely unexplored. Without astronomy, time would still be measured by

candles and water clocks

Astronomy has gradually enabled us to understand the structure and workings of the wonderful machine we call the solar system. Little by little, man has come to understand what causes the varying engine of day and night, the changing seasons, the tides, the eclipses, and all the other phenomena that puzzled and awed men 5,000 years ago.

As man's knowledge of the world in which he lives increased it became more nearly exact. For instance, hundreds of years ago men were satisfied to say that the North Star marked the north pole of the sky Now they know that the North Star revolves in a small circle around the true north point which marks the earth's axis

To find this true north pole is of course necessary before an equatoral telescope can be mounted to follow the stars accurately. True north is also needed in order to mount a sundial properly. A simple experiment with two plumb lines will enable you to find and mark the true mendian once for all. This north and south line can be laid out upon the floor or roof, or across the top of a post outdoors of in any other convenient place.

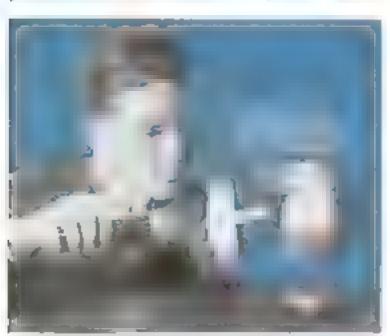
If you decide to mark the meridian upon the floor, select a window facing the north, from which you can see nearly to the borizon. From a tack in the ceiling or the window casing, hang a small lead weight. Let the little weight hang in a glass of water so that the plumb line will come to rest quickly and be less in-

supported by a small movable stool or pile of books on the table, hang another short plumb line. Now your apparatus is complete, except that a dim lamp or candle should illuminate the vertical cords so that you can see both of them and the stars at the same time

Your problem is to move the stool until its short cord is in line with the longer cord and the pulestar, and to do so at the exact time when the potestar is vertically above or below the true north pole of the sky

The is really easy to do, for the polestar is always vertically above the true pole when the star at the bend in the handle of the big dipper is vertically below the polestar

During November and December, the Big Dipper is swinging across the sky below the polestar (P.S.M., May, '33, p. 46) at convenient evening hours, so all you have to do is to watch it until the star at the bend in the bundle and the polestar are both in line with the long





WHY SUMMER IS NOT AND WINTER COLD

A globe, a flush light and a piece of curdboard with a equare hole cur in it, are used to demonstrate the heat of number. The light rays, hitting the globe vertically, as in the first picture, cover a mail square and hence are intense. When the tays hat at an angle as in winter shown in the second picture, they cover a rectangle. As a result they are diffused and so give out much less heat.





To find zero moth, at he scale is not to the s

easons

cord. Then shift the stood and the shipments cord until the two cords conneid with the potestar, and rule scross the table top a line joining the two cords. This true north and south line can then be transferred to the door by plumb cords hung from the ends of the ruled line at the table edges. After this is done, you can set up your telescope at any time with its polar axis paradel to the meridian line on the floor

This little table gives you the days and hours in November and December when the star Mizar, in the dipper's handle, is vertically below the polester

Nov. 25, 8 40 P.M.; Nov. 15, 9 20 P.M.; Nov. 25, 8 40 P.M.; Dec. 5, 8:00 P.M. Dec. 15, 7 20 P.M.; Dec. 25, 6 40 P.M.

During spring and aummer, you will find it more convenient to sight by the star called Delta Cassiopeiae, as the Wshaped group is then below the pole, with the dipper sating high in the sky above it

Now let us do an experiment that shows the difference between solar time (sun time) and standard time. It was also expens why almost the whole world uses the latter

If you look at a globe, you will see a succession of straight lines ruled at equal intervals from pole to pole. These are twenty-four of them, corresponding to the twenty-four equal periods of time required for the earth to turn completely around on its axis. Since the earth's circle is 360 degrees, each meridian is fifteen degrees from the one following it

As the earth turns eastward, the meridians pass successively into line with the sun. As the plane of each meridian crosses the center of the sun, it becomes noon at every point along that meridian, from pole to pole. If we like, we can therefore think of noon as a north and south line that moves constantly across

sun-in half of the w

Now stop thuking about the earth as a whole. Consider only a strip of its surface extending across the United States. On a curved model of this strip the four hourly meridians crossing the United States are spaced fifteen degrees apart and accordingly numbered 75 00. 10° and 120 degrees respectively

On each of these mends and, we place a small sundial and are ready to watch the noon line sweep across our ormature country!

To glast with, we will bold the curved map about a dozen feet from a strong incandescent lamp, which represents the sun. Hold it first so that the shadow on the dial at the mendian of Philadelphia (the 75th) indicates twelve o'clock noon. Wathout moving the map note that each of the shadows on the drais at St. Louis. Denver and east of San Francisco indicates a time an bour earlier than the next one eastward.

Then rotate your body toward the east, moving the map slowly with it. You are turning the earth from west to east. As you do so, look down at the shadows on the dials and watch them shift. Soon the Philadelphia dial teads one o'clock and the noon line has moved on westward to St. Louis. As you turn farther, noon sweeps on to Denver and finally to San Francisco. When it is noon there, the dial



MINISTE D

CHAMED

It universations showing the position of the United States as seen from the sun in waver and summer. The difference is due to the north pole tilting away from the winter sun



EARTH'S ORBIT AROUND BUN

In its revolution around the sun, the earth moves further from the sun in summer as the flustration shows and hearer time ther. The inclination of its axis however turns the north poly toward the sun it summer and away in whater, causing long summer, and short winter, days

As everybody knows, standard time also shows a difference of three hours between Philade phia and San Francisco so why wouldn't solar time do just as well? Why has standard time been established everywhere?

The answer becomes apparent when we compare the solar times of places less than one hour (Continued on page 103)

ACCIDENTS still produce

Great Inventions

By EDWARD THOMAS

over his lunch caused a man to make a val-Jable invention and a comfortable fortune as well. This strange fact is revealed in a patent aw decision just hanner e own by Julge John I Nields of the United States District Court of De aware W.J. iam. H. Mason

AWDLING

the fortunate inventor in an effort to produce at low cost, a good, marketable paper was experimenting with fibern made by explod

ing wood in an entirely original process. Chemists had told him his fiber was useless für making paper because his process faired to eleminate the guirmy salestances called ligning which constitute had or more of the wood and seriously weaken any paper that contains them.

Mason, however, relused to listen to his chemical advisers and persisted in testing his process. In the spring of 1925 he shipped half a carload of his exploded wood fiber to a paper mill in Wisconstn. where he was allowed to treat his fiber by putting it through beating engines of various kinds. Among the machines be was permit ed to use was a so-called Fourdrinier machine, in which the water carrying the fivers flows onto an endless helt that forms the paper sheet by draining off the water

In one of his experiments, Mason made sheets out of his exploded wood obers on the Fourdringer machine and then placed the sheets, for thorough drying, between the steam-heated plates of a power-driven press. This method, he firmly believed, eventually would produce a strong, durable paper

One day, whose engaged in this particular test he went out to lunch with one of the young engineers at the mill. Before leaving, he shut off the steam, or thought he did. Their lunch finished, the two friends for almost an bour sat chatting over the coffee cups. When they returned to the plant, Mason discovered that a steam valve had broken down and failed to shut off the steam when he had turned it before going out. As a result, the thick sheet of fiber, instead of being merely dried, had been baked for more than an bour by hot steam.

Mason thought the sheet must be spared but decided to test it before



Far he it from me to advocate langer og over luncheon as a tued to rights but one man made a fortune by during upt this

throwing it away. To his astonishment and delight, he found that, instead of making paper, he accidentally had invented a fine, strong, and almost waterproof granless wood.

Now Mason got busy in earnest. He screwed the press up to higher pressures, lightening it as the steam dried out the moisture, put fly-screen wire between the press so moisture would escape easily and modified the process in other ways. Finally, he found that he obtained the best results with the press exerting a pressure of between 200 and 700 pounds per square inch and the steam at a temperature of about 320 Fabrenheit

He built a factory and, as the grainless board proved eminently suited to making door panels and many other carpentry and cabinet jobs, his product sold so well

that a rival firm applied a similar process to the sugar-cane waste known as bagasse, and sold baked bagasse board in com-petition with him. Mason sued for infrangement, and Judge Nields has just decided in the rival's favor. But from all I can learn, Mason has nothing to worry about in a financial way

This man, you might say, made his fortune by having a second cup of cuffee. For had he returned promptly from his midday meal, he would have discovered the broken valve and probably would have shut off the steam just in time to prevent the fiber sheet from becoming a grainless board and himself from becoming a wealthy manufacturer. Far he it from me to advocate langering over lunch as a road to riches. I pass Mason's story on to the readers of Post LAR Schence MONTHLY because, in a quarter-century of practicing patent law, I seedom have come across a more striking example of accidental invention.

Of late, there has been a growing tendency to belittle the element of chance in the field of invention and discovery. We live in an age of coordinated effort. The poor, lone inventor hard at work in his garret laboratory has been all but relegated to the realm of fiction, and the belief is gaining ground that accentific and mechanical progress is largely a matter of the right kind of organization.

I know that this theory has yielded remarkable results. The work of the research staffs of the great concerns maintaining aplendidly equipped laboratories for the purpose, produces thousands of patents each year. But I also know, from personal contact and observation, that the

HERE you have the dramatic story of great in-ventions born of lucky accidents and strange twists of chance. It is an inspiring account of inventors whose alertness enabled them to grasp mistakes and make them pay. A broken-down mixing machine, a cracked thermometer, a defective steam valve—out of such annoyances have come discoveries that made millions. The author of this article is a well-known patent attorney in New York City



Al no in H & Garat

ping red to the rea

namber of fine soven look and toscoveres made under the chaper or | | | | | | | | | |

large enough to put new heart into the most cocouraged inventor

Paradoxically, a dismata assumed of chains taking a hand in the lution of a takinsh problem occurred th one of the huge industrial and atories to which I have just referred. This particular research stall at the time was work by the development of a quick-drying fairsh for automobiles. Jurni are, and other minuar things,

Experiments had progressed to a point where

the chemists knew they must use natrocellulose as the basis of their mixture. But the concections they at first produced did not contain enough nitrated cotton to give them a facquer with sufficient body to stand up under rough usage. The problem seemed simple: put in more nitrated cotton. The result was a jellylike mixture

that would not apread.

For a while the tests were abandoned. Then, one but day, a new batch of the thick stuff was prepared and put in a big container, ready to go to the mixing muchine. Just for luck, one of the chemists put some caustic soda into the mixture. But at the moment the jelly was about to be poured into the mixer, the machine broke down. The repair job took several days, during which the container with the compound stood forgotten in a corner of the laboratory.

When finally, the mixer again was in working order, the contamer was wheeled to the machine and the lid taken od. To

to the machine and the lid taken off. To the amazement of the staff, the jellylike mass had turned almost as then and as clear as water. The stuff was tested and proved perfect for its purpose. A few days' time, some summer heat, and a prach of sode had done what a laboratoryful of chemists had been unable to accomplish in several years of deaberate experiment

The secret of making synthetic indigo from naph halone was discovered in similar accidental fash ion. Chemists work he on this problem were stumped in their search for a catalyst that wook produce the necessary coudst on the line mortong, a young laborative assistant staking a thermometer into a container file!

Madera Research Work

Great commercial concerns maintain splendedly equipped laboratories and in them many thousands of valuable patents are being produced each year

with an unsatisfactory experimental mixture accidentally broke the glass tube and the mercury ran out. Eurekal The desired chemical teaction occurred at once, and abortly afterward synthetic indigo was on the market

Or take the way in which the first and the dye from coal tar was made. For no particular good reason, the discoverer, a chemist named Perkin, believed that quitine could be extracted from coal tar. At the end of one of his many experiments, Perkin, perhaps for the twentieth time, found hamself the discouraged pussessor of a useless black mess. He was just about to throw it out in degust when it occurred to him to odd a dash of alcohol to the mixture. Instantly, the gummy mass of pitch assumed a hir hant purple town—and anome ove was discovered by this unexpected accident.

Some months ago. I told the readers of this magazine (P.S.M., Aug., '32 p. 103) how the English mining engineer Cattermole, by observing how the dirty water behaved while he was washing his oil stained hands without soap, accidentally discovered a new method of treating ores that later was developed into the fathous and valuable froth-flotation process,

Another celebrated discovery (and, inindentally, another milionaire) was made
because a chemist did not wash his hands
at all. In the midst of an experiment, he
happened to eat lunch at the shop one
day without having made the preparatory
tip to the spigot. Munching a roast beef
sandwich, he noticed that it tasted sickemingly sweet, laid it down, and rose to
cet a class of water. As he turned the
tap, the thought suddenly struck him that
he had forgotten to wash his hands. A
takeful examination of the materials he

had handled just before eating led him to the discovery of succharine!

The lucky inventors of whom I have told you had one thing in common—they all knew a good thing when they saw one. Unfortunately not everybody is blessed with usight imagination and the animaly to seize upon a fluke and turn it to pracural account. It is the possession of those qualities that spe is the difference between a real inventor and a more experimenter or tinkerer. It goes without saying that finding a diamond in the street wouldn't do you much good unless you recognized it as a precious stone lostend of glass.

As everyune knows, Charles Goodyear discovcred the process of vulcanzing rubber when he accidentally hit a hot stove with a mixture containing rubber and sulphus. He lost no time in getting a patent, and a wateriight one, too, that the inventor who, seventy years later, discovered that rubber was enormously strengthened by mixing in a large proportion of carbon black, possessed neither the imaging-

tion nor the smart business sense that characterized Goodyear. He did not realize the importance of his achievement and fasted to get a patent. Hence no inventor has profited by so much as one cent from the discovery that a rubber tire will run 20,000 miles if the rubber in it contains forty percent of carbon black while a similar tire made from rubber containing only five percent of carbon black will wear itself out in 5,000 to 10,000 miles.

The fortunate inventors I have mentioned had another thing in common. You doubtless have observed that in each case, the invention was made in the course of another, sometimes unrelated, experiment. The majority of accidental inventions are made that way. It has, therefore justly been said that this type of accident usually happens to those who deserve it, that is to say, those who, by much hard work and cornect thought have prepared themselves for a visit of Lady Luck.

Thus it was while experimenting with photography that Daguerre left an exposed photographic plate in a closel that happened to contain an open dish of mercury and (Contained on page 101)

Biggest & Sky Sign Flown by Autogiro

What is said to be the largest aerial sign ever towed into the sky was recently peeled from the ground at Curtiss Field. Valley Stream. V. Y. and down over New York City. With letters nine feet high, it was longer than a try block. How the huge display was prepared and flown as shown by these photographs made especially for Forestan Science Monthly. The separate letters, each having a strengthening rod of bamboo or duralimin, are laid out on the ground and joined by

snapping buckles on fabric straps which run lengthwise of the sign. A 400-foot rope runs from the head of the sign down wind to the actugiro which is turned facing the breeze. When all is ready, the pilot climbs steeply into the air and fises back over the sign, which peels off the ground behind it, the end of the display leaving the ground inst. In this manner, the letters are no, dragged along the ground and mjured. At the end of the flight, the tope is released by the pilot when a hundred feet above the field and the sign drops safely to the ground so it can be used again.



One of the bamber poles and arraps that he a the name foot letters in a gigantic sky nigh



Autog ru. r a ng ateep'y nto the air against the wind, raised the big sky a ga behind t so the secret would not be dragged a ung the ground

t down on the pen positive toakes in fine or

The biggest sky sign ever flows weblaid on on the ground. When som-

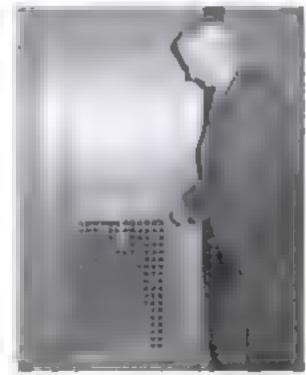
piere. I was congue than a city block

POINT ON NEW FOUNTAIN PEN CAN BE MADE FINE OR COARSE

Ax adjustable point that writes in nine degrees of fineness is the feature of a new fountain pen of well-known make. The adjustment is made by moving a slide up or down along the point, which varies its flexibility. Besides being able to suit the point to his own handwriting the user can adapt it to fine writing.

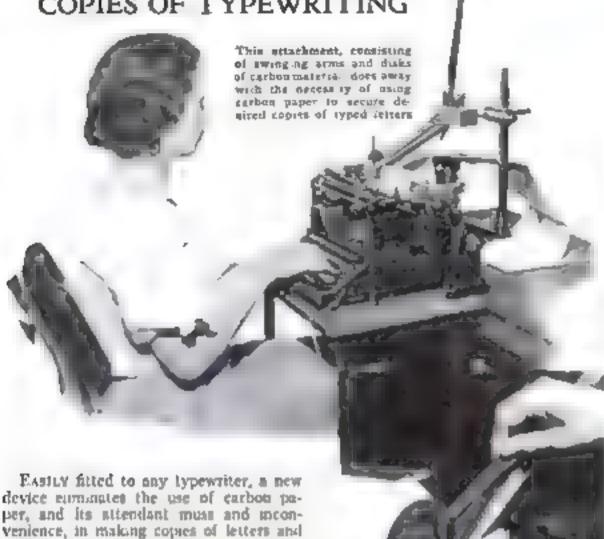
HEAT CLOSES FIREPROOF SHUTTER

To GUARD the archives and furnishings of the United States Capitol at Washington, D. C., against destruction by fire, the time-scarred wooden doors of the building have just been replaced throughout by freproof doors of the latest type. The new-style door is of metal construction with a ventilating panel that ordinarily remains open. In case of fire, however, a fusible link melts and alluws a steel shutter to drop in place over the panel barring the passage of the flames. The photograph shows David Lynn, whose official title is Architect of the Capitol, examining one of the new doors and the fusible link that operates it. The link has been detached and placed beneath the steel shutter for inspection, as is clearly seen in the picture.



David Lyon, Architect of the capital, Washington, D. C., enamines a fireproof steal door

CARBON ON DISKS MAKES COPIES OF TYPEWRITING



venience, in making copies of letters and business forms. It comprises a series of swinging arms, each one bearing a replaceable disk of special carbon material mounted on a frame that can be attached to the machine or detached in a few secunds. As many disks are inserted between the sheets as copies are desired. Each disk revolves as the typing proceeds, continually presenting a fresh surface. When the typing is done, the disks are awang out of the way and a perfect set of copies is immediately at hand, without need of separating them from sheet carbon If at any point in the typing it is desired to omit prices or other data from one or more copies a louch on any one

Cines-up showing how the carbon dish is shouted between sheets to secure copies

of a set of keys at the top of the attachment flips the corresponding disk out of writing position, as shown above

DOUBLE CHESS BASED ON MODERN WAR

Atralants" replace queens and "general staffs" play the part of kings to a new pastime known as "double chess." Devised by a Russian inventor, A. (Yurgelevich, the game is gaining popularity in that country. It is derived from thess, but the rules and stratery

have been modified. The appear-



formed in order to modernize the game and simulate present-day warfare. To make room for an up-to-date military campaign, the board contains double the customary number of spaces. Gone are the old pawns, rooks, bishops, and knights, their places are taken respectively by "soldiers," "heavy

knights, their places are laken respectively by "soldiers." "heavy artiflery (symbolized by thick cartridges)," "machine guns (represented by slender bullets)." and "cav-

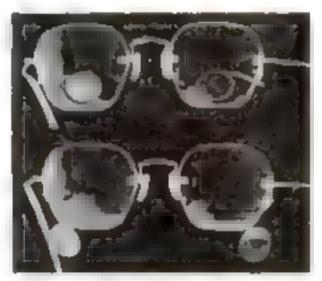
afry," A new piece known as a "tank" has been added. The object of the game is to destroy the active forces of the enemy and to capture or declare checkmate against the hostile general staff Each of the pieces have powers of movement and destruction according to its specific function in actual warfare.



Pressing a burrow opens this mailbox and a apring within it thus delivers the letters

BUTTON OPENS MAIL BOX AND DELIVERS LETTERS

When his mail box broke, an inventive Cleveland, Ohio, man decided to make a new one himself—and to improve on the old one. The result is a box that may be opened, after unlocking, simply by pressing a button. An inner container springs up in response, bringing the mail with it. To close and lock the box he container is pushed back into place When the box is locked, the button may be struck hard without opening it.

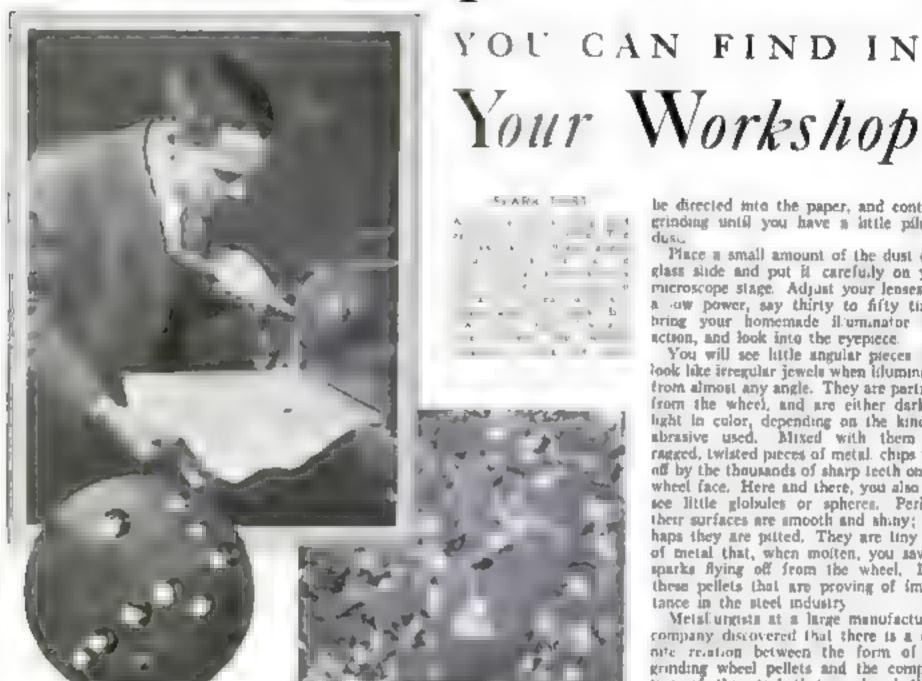


These two views of conversible speciacles abow them with the ceading lenner awang and also in the biforni pour on

SPECTACLES ADJUSTABLE FOR FAR OR NEAR SIGHT

Convertible spectacles, instantly adjustable for near or far vision, are the invention of a Chadron, Neb., optometrist. For close work such as reading. writing or sewing, a small guziliary lens is swung in front of the main one on each side. Mounted on pivoted arms, the movable lenses are easily pushed out of the line of vision when not needed. Thus the user may look straight ahead at all times, instead of being obliged to tilt his head as with the ordinary befocal glasses. According to the inventor, the supplementary lenses may be attached to any spectacles thus changing ordinary street glasses into those that are suitable for reading and other short distance work

Microscopic Marvels



ERHAPS the chief reason why the use of the microscope is growing in popularity as an instructive and fasonaling healty is hat it makes two worlds visible where only one was seen before. This is true of any shop whether it he your own place in a corner of the basement or a unit in a mant lactory

Visit your workshop or that of a feiend Look about you. There are lathes, power saws, drill presses, hand tools of all kinds scraps of iton and steel, a pile of lumber, and a box full of odds and ends. Your interest in these things is determined by your knowledge of their purposes and the

manner in which they are used Now take your microscope into the same shop and peer through it at the various things you find there. You will discover beauty in the scrap box, romance in a rusty piece of steel, a fascinating story in the dust that collects around a grinding wheel, mountain ranges on a file and a bost of other things that you never even dreamed were there. The microscope, in fact, proves that every shop is really two: the normally visible one of tools, steel, and wood, and the one of cells, crystals and particles that is revealed by your microscope

When you grind a piece of metal on

an obtasive wheel showers of beautiful sparks by off. For years, steel experts have been observing spark [colors and thus identifying diff

loys. But the method has its limitations, for some m tals defy identification in

With your microscope you are prepared to follow the steps of metallurgists who, not long ago, found a way of going the spark system one better. Place in front of the granding wheel a sheet of newspaper folded so that it will catch the dust driven off when you grind a piece of steel Select a piece of metal that will produce sparks generously, such as an old file Hold it against the wheel so that the spark shower will

HOW YOU CAN STUDY WOOD

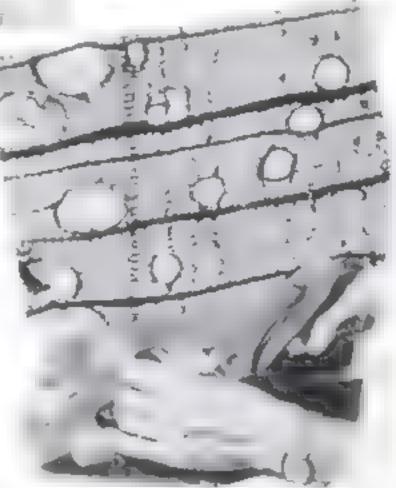
Right a plane may be used to get wood sections for the microscope. Above it is a crosssection of black walnut that is enlarged about 60 times

he directed into the paper, and continue grinding until you have a little pile of

Place a small amount of the dust on a glass sinde and put it carefully on your microscope stage. Adjust your lenses for a ow power, say thirty to fifty times, bring your homemade illuminator into action, and look into the eyepiece.

You will see little angular pieces that look like irregular jewels when klummated from almost any angle. They are particles from the wheel, and are either dark or light in color, depending on the kind of abrasive used. Mixed with them are ragged, twisted pieces of metal, chips tern off by the thousands of sharp teeth on the wheel face. Here and there, you also will see little globules or spheres. Perhaps their surfaces are smooth and shiny; per-haps they are pitted. They are tiny bits of metal that, when motten, you saw as sparks flying off from the wheel. It is these pellets that are proving of importance in the steel industry

Metallunguan at a large manufacturing company discovered that there is a defione relation between the form of the grinding wheel pellets and the composi-tion of the steel that produced them It happens that steels, difficult to classify by the spark test, can, in many cases, be identified by examination of their pellets.





You can have a lot of fun collecting pellets from different kinds of metal objects and looking at them through your micro-

suppe.

Even If your instrument is not a very powerful one, it will show you the structure of metals just as the expert microscopist in a steel plant laboratory sees them. The microscope is largely responsible for development of metals and alloys that make possible the automobile. Ar plane, and almost every other piece of modern machinery. Under its revealing eye, the crystal ine grains of metal are as plain as the bricks in a pavement

Iron and steel being the most common workshop metals, you doubtless will want to examine them first. If specimens of them are prepared in the manner about to be described their structures can be seen with a relatively low-powered microscope.

Nearly pure iron exhibits beautifully the crystaline grains that make up metals. These grains, when the metal has been polished and eithed lightly with a chemical, are outlined by fine lines. Further eithing results in a change in color and tone of various crystals. Still deeper eithing often brings out the three-dimensional form of the crystals.

Metallugists have given names to the various things that can be seen in a piece of iron or steel. If you examine wrought iron, you will see dark streaks or spots extending through the crystals. These are slag particles clongated by pressure used in shaping the metal piece. Some curbon may be present, but it, in union with other materials, is found between the crystals rather than inside them.

Mild or low-carbon steel in nothing more than wrought iron from which the slag has been removed. In structure low-carbon steel in a mass of carbonless from crystals, which the metallurgist calls ferrite, with here and there between grains, dark patches containing the carbon. These

patches sometimes shimmer in the light like mother-ofpearl, which it the reason the substance forming them is called pearite

When suth tently magnified, these pearlife spots are seen to contain afternate dark and light streaks or plates. These may be about 1,25,000 of an inch thick. The dark streaks are ferrite or iron which has been stamed by the etching solution. The light streaks are iron carbide or cementite it is interesting to note that genuine mother-of-pearl is made up of layers of thin plates that reflect light in a striking manner.

As the amount of carbon

in steel is increased, the areas of pentite become larger and the grains of ferrite smaller until, when the amount of carbon is nine-tenth percent, the steel is all pearlite

The preparation of specimens of iron and steel for study is not complicated. You will be wise to start with east trob, because it responds readily to the treatment. Later, you can tackle more difficult material.

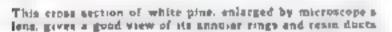
Although many steels have to be heated to about 1.800 degrees habrenhelt and then cooled slowly in order to remove strains and make the structure uniform, you will not have to do anything of the sort to east iron

Fe or grind the surface to be etched, until it is bright and smooth. Then polish it with abrasives of increasing fineness until the metal has a mirror-like appearance. You can use emery paper for rough polishing, starting with a fine grade, and foreshing with the finest you can get. Another way is to make a lap by tacking a layer or two of broadcloth over a wood block, wetting the cloth, and sprinking fine powdered emery over it. For final polishing, use powdered rouge and a appendiant to that employed for emery

The next step, after catefully washing and drying the polished surface, is to apply the etching solution. Its action on the metal surface causes the grain structure to become visible. Some parts are attacked more extensively than others. Also some of the materials in the metal are colored differently from others. There are several different kinds of etching solutions that you can prepare

One reagent consists of five grains of pieces acid in about three and one half ounces of absolute alcohol. Immerse the metal for thirty seconds.

Another (Continued on page 92)





New Tools Straighten Oil Wells



O SOLVE it perplexing mystery Alexander Anderson, petroleum engineer of Fulierton, Calif was railed not long ago to a western oil field. Two wells put down in a promsing area had struck oil, and the producers, rejoicing at their success, had and ed a third well between the two Strongely enough, although they added section after section to the string of pipe that retated the drill, the well did not produce oil. According to theory, oil must be there but it seemed impossible to and it with the third well

Into each well, in turn, Anderson lowered a long, slim instrument resembling a gun shell. It contained a photographing surveying apparatus that recorded at variour depths the tilt of the hole. Its disclosures were surprising. The first well drailed should never have struck oil at aland wandered by chance into the reservotr. Well No. 2 went straight down to the oil as a good well should. Well No. 3 started all right, and then veered off on an erratic slant that took it entirely out of the producing area.

Wandering oil wells are now a recognized problem of the oil fields, for it is hard to keep a hole going straight as far as a mile or more below the surface. Cases are recorded where a pair of wells, started as far as 2,300 feet apart, have actually run into each other in the depths of the earth, and mud from one has entered and come up the other

OF WILL 472 4000. At point A these two we'lly were so close together mud from one rose in the wheel

To enable drillers to keep their shafts straight, a remarkable method of subterranean exploring has been devised by Anderson. It uses three ingenious devices known as the "underground survey instrument," the "single-shot magnetic survey astrument" and the "go-device". The underground survey instrument

gives a complete survey of the well from top to bottom. When its waterproof shell is up-ended and lowered into the hole, a photographic film automatically starts moving downward past an aperture where a flashing light beam registers periodic marks upon it. The beam is directed upon the film by a multiple swinging mirror. hung like a pendulum, so that the resulting film record will show the tilt of the instrument when each flash occurred. By timing the descent of the instrument with a watch, as the measured strang of pipe is lowered with the instrument from the mouth of the well, the surveyor is able to know when the instrument reached each depth level and consequently at what

FILM ON MOV-ING CYLINDER

LAMP FLASHES AT PER ODIC INTERVALS

BALL SWITCH STARTS AUTOMAT C MECHANISM W EN MISTRUMENT IS GP-ENDED

> Illugtent on showing parts and operation of instrument to keep al of wells straight

tepib each on he marks registered on the the was made. The resulting from shows every turn and twist of the well-

If a reading is desired only at one certain depth, as an occasional check in drilling a new well, the magnetic survey instrument is lowered on a cable to the bottom. After a pre-determined time, a clock closes an electric contact that forces a pair of plumb bobs against a pair of composition disks that record the engle of till. At the same time four magnetic compasses are clamped to lock their reading. The go-devil is a similar instrument, but the plumb bobs are actuated by a trigger from a grease chamber, controlled by appiving pressure at the mouth of the we I. Through the use of these instruments, wells are accurately surveyed.



TRAFFIC LIGHTS FOR BRITISH PORT

TRAFFIC lights to control the movements of hoats entering and leaving a harbor are an innovation successfully tried in England. The lights have been mata led at Yarmouth, British scapart and center for berring and other fishing industries, and enable big liners and about 2,000 berring boats using the same river entrance to operate without interference. Visible two and a half miles away, the signate direct the comings and goings of the fishing fleet. The tamps are in-stailed on the harbor master's home,



These lights guide ships to and out of Yarmouth harbor

Bellieven to be the fastest man-propelled vehicle in the world, a streamlined bicycle has been devised and named the "velodyne" by Marcel Bertbet, French cycle champion. With this machine, the inventor declares, a cyclist can easily at tain speeds of furty miles an hour, and can even exceed a mile a minute for brief sports. The rider enters the "tear-drop" shell through a door cut in the side, and gets under way with his bead lowered below the level of an aperture at the top. A small rectangular peephole cut in the front, at eye level, provides forward vision. Since the rider is almost completely inclosed in the stream, med fairing. which presents a frontal width of barely

two feet, wind resistance is reduced to a minimum. The design of the "velodyne was worked out according to aerody-

namical principles with the assistance of

Marcel Riffard, chief engineer of a promi-

cent French urplane firm.



CYCLISTS' MOLDED MASKS

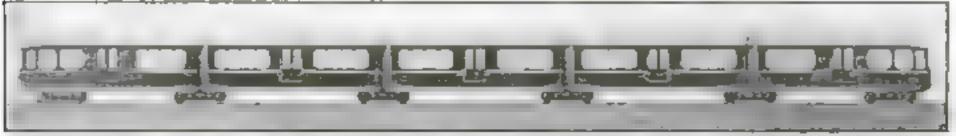
For races on cinder tracks, daredevil-New York motorcyclists wear gratesque masks to protect their faces against flying particles from the wheels of each other's machines. The racers dip the masks in water to soften them and then press them against their faces. When dry, the masks take on the contours of the cyclists' features. Goggles are worn over the eyeboles. In addition, the racers wear football belinets to guard their heads.

FIVE-SECTION, ALUMINUM SUBWAY CAR IS NOISELESS

SWIFT and virtually noiseless, a rapidtransit car of radically new design has been perfected for service on elevated, and subway lines through the joint research of several of the country's leading manufacturers of realroad and electrical equipment. The new car is 170 feet long, made of aluminum alloys similar to those used in airships, and is divided into five articu-

lated sections with vestibules giving access from one to another. Since its weight is only half that of the whole train. that it replaces, it can be started and stopped more rapidly and can therefore run no a considerably faster schedule Despite the cars' rapid pick-up to its full speed of fifty mules an hour, an automatic electrical control makes the increase in

speed so amnoth that passengers who are standing will not be thrown from their feet or suffer any inconvenience. An improved system of granng using roller bearings, banishes noise from worn gears Now under construction in Chicago, the first multi-section car of the new design is expected to be placed in experimental service on a New York elevated line.

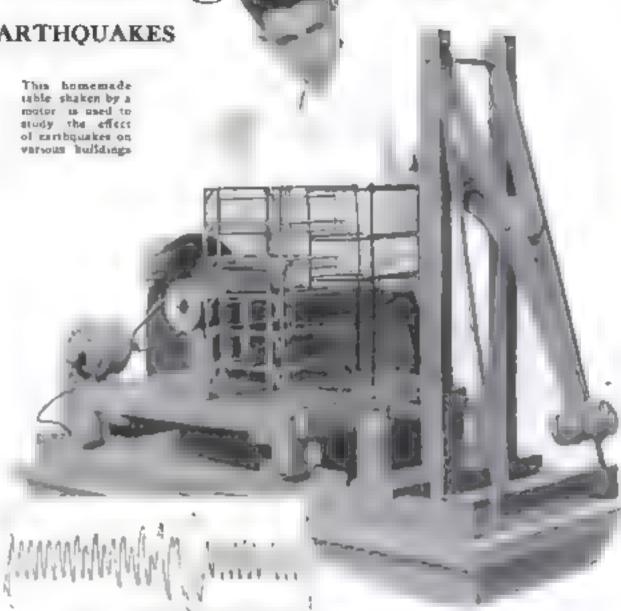


Thus radical rapid-transit car is to be tried out in New York. It will be 170 feet long and will make 50 miles on hour

Homemade Shaking

HELPS STUDY OF EARTHQUAKES

INTERESTED in a description be read in this magazine of a "shaking table in use at Stanford University for study ing the effects of earthquakes with model building (P.S.M., April, '33, p. 16), Cedrie W. Richards, architectural student at the University of Nebraska, resolved to construct a working model of the Stanford apparatus. Added by his father, he built the ingenious miniature shaking tuble piclured here. An electric motor spins an unbalanced "flywheel," a bar of iron an inch square and six inches long, mounted a one end to give the nineteen-by twenty-four inch platform a continuous oscillating motion. Single shocks of any destred magnitude are given the piatform by dropping a beavy, pivoted bammer against a coll spring at its end. Models of building frames are mounted on the platform, which rolls on four wheels along a steel track, so that their sway in response to the vibrations may be demonstrated. An automatic machine, somewhat resembling a seismograph, records the intensity and duration of the shocks to which they are subjected. While Richards built his device primarily as an exhibition model, he believes that it can readily be adapted to useful scientific research in the investigation of earthquakes and the bration caused by heavy traffic.



CAMERA GUIDES SHIP THROUGH FOG



With this camera, pictures are made by infracted light and developed within thirty seconds. They guide a ship through beavy fog

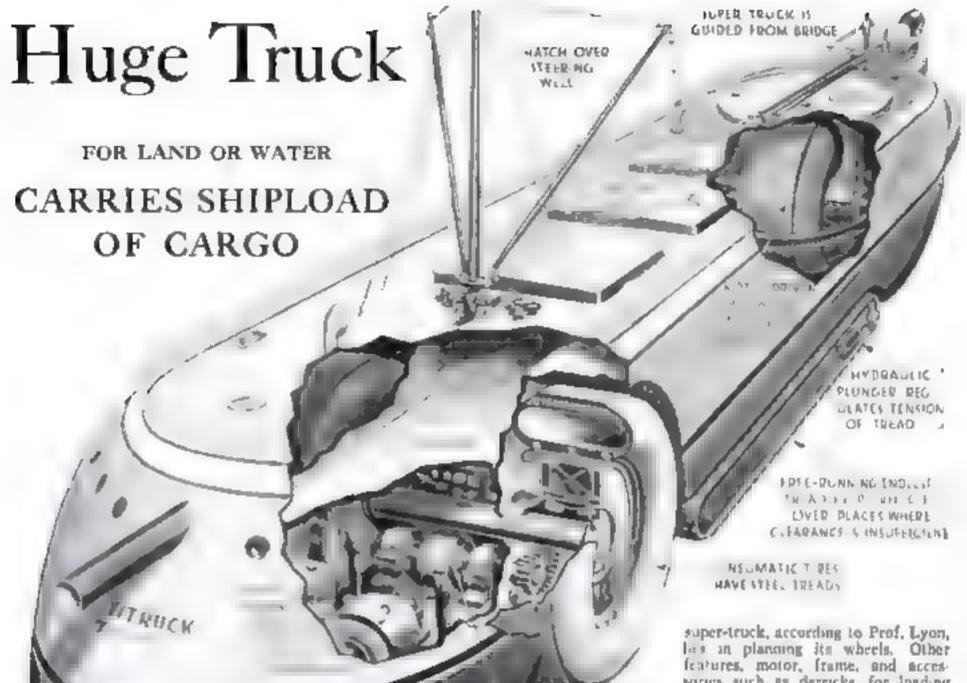
Gt mixa a ship by taking pictures of the nutlook ahead is the method proposed by former naval officer, to combat fog at sea. During a recent voyage of the oner Manhattan he demonstrated his "invisible ray camern," designed (or the purpose, which makes photographs by means of the fogpenetrating rava of infra-red light. Developed immediately the pictures can be viewed within thirty seconds after exposure and are said to show 'objects four and a half times as far away as the eye can see The invisibleray camera would be especially useful, its inventor decares, in negoliating a narrow and tortuous channe. or harbor entrance obscured by for. The accompanying photograph shows two models of the instrument being tested.



Platform

DIRT IN CAR'S OIL SEEN WITHOUT AID OF EXPERT

Any motorist may see for h mself without consulting a service-station attendent, whether the oil in his car a crank case is dirty and needs changing, if he uses a demonstrating device intended for service stations. A sample drop of oil from his car's crankcase, in placed on a white card, clipped to a side, and inserted in the instrument as shown above. Then, when a button is pressed, a flash ight bulb fluminates the card and specks of dirt or hearing metal are made plainly visible to the motorist himself through a magnifying eyepiece at the top.



ROLLER

+AR NGS

DRIVE PINION

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PROPERTED AND

EDODER ARE USED

N CROSS NO PATER

MAGINE a motor truck so sarge that it dwarfs the biggest locomutive in the world -a veritable ship of the land, rolong on pneumatic ures as high as a bungalow. Fit this juggernaut, in your mind's eye, with a boat-like bull a Diesel motor and an electric drive; add a propeller and rudder so that it can pavigate in the water as well as on dry ground, fill its capacious hold with hundreds of tons of cargo, and send it roaring across the continent or through a wilderness to its destination. Then you will have a mental image of the 1,500-ton, amphibian supertruck that Eric R. Lyon, associate pro-fessor of physics at the Konsas State Agricultural College, predicts will be the freight-carrying vehicle of the future. To prove it feasible, he himself has worked out the engineering design of such a machine, which he calls the "navitruck," and which our actist illustrates here and on the cover of this issue.

These super-trucks will be operated on commercial highways, privately owned and operated, Prof. Lyon foresees. The roads, needing only to be sanded or graveled, can be constructed at one-third the cost of building a railway. No bridges are required, the super-trucks will ford all streams. In a real sense they will be liand ships," since each one carries as much load as a fair-sized cargo vessel, and both the operating plans and the freight charges will approximate those of water-borne shipping.

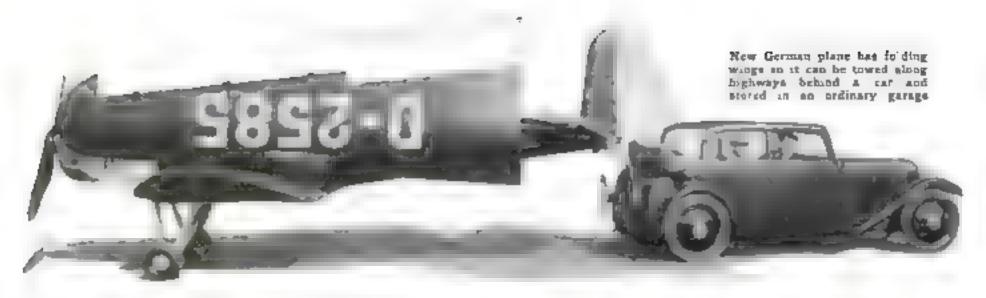
Super-tracks will prove their worth especially in the western United States. Prof Lyon predicts; while they also offer a menos of opening inaccessible regions of Canada, Asia, Africa and South America, rich in mineral and other resources, to commerce. A sloping prow at the front of the machine will serve as an ice-breaker, or will clear the way over infrequently-traveled trails through tropical jungles.

The principal problem in projecting a

las in planning its wheels. Other features, motor, frame, and accessories such as derricks for loading and unloading cargo, offer no serious engineering difficulties, despite the hage scale of the project. To carry the vehicle's crushing weight smoothly and rapidly, Prof. Lyon has worked out several ingenious designs for steel-shod, pneumatic tires thirty feet high, and with treads ten feet wide, revolving on gear-driven rims.

The huge pneumatic inner tube, partitioned by bulkheads to avert an explosion in case of a blow-out, is covered with alternate layers of fabric and armor of steel cable or tubing. An outer, renewable rubber tread permits high speeds on good toads. In case of a leak a man can china through a manhore in each tire section and make a repair. However, each tire contains an automatic electric compressor that will maintain the required sixty pounds pressure despate all but the severest leaks. An auxiliary endless tread amidships helps the super-truck over obstacles

Roads suitable for the super-trucks will be forty feet wide for one-way traffic and eighty feet wide for two traffic lanes, Prof. Lyon estimates. They will be easy to maintain in good condition, since the massive wheels of the monster truck act as road-rollers and pack the surface more firmly each time they pass over it. Super-highways of this type will be constructed. Prof Lyon predicts, radiating from Denver, Colo., to Duluth, Minn., to Kansas City, Mo.; to Galveston, Tex., and, by way of Santa Fe, N. M., and Phoenix, Ariz., to Los Angeles, Calif. He also predicts a super-highway for the grant trucks from Canada to Mexico by way of the 100th meridian.



Flivver Plane, with Folding Wings, Is Towed to Air Field

INTENDED especially for the amateur pilot, a new type of light plane, developed in Germany, is designed to be towed by an automobile to and from the flying field. The wings fold so that the machine offers no obstruction to traffic while it is on the highway, and it may be stored at home in an ordinary garage. In the air, the plane can attain a speed of sixty-five miles an hour. It is expected to be marketed at \$700 and its designer says it may be the air fivver of the future

WORLD'S MIGHTIEST DREDGE TO CLEAR FRENCH HARBOR

RESENBLING a vessel sheed in two, the world's most powerful dredge, named the Pas-de-Caluis II, was launched at Dunkirk, France, the other day Its endless chain of buckets is lowered through a well that extends from amidships clear to the stern, and can scoop up mud from as far as seventy-five feet below the surface, at the rate of nearly 800 cubic yards every hour. Each minute fitteen buckets take their bite out of the bottom. The first task of the big vessel, which incasures 236 feet in length and forty-three feet in width will be to improve the harbor of the French port of Boulogne-sur-Mer. At present the vessel is designed to hurn pulverized coal, but a later installation for fuel uil is contemplated



Natives in the jungles of British Gurana protect themselves from the sun beneath big umbrelle feaves



UMBRELLA LEAVES WORN IN JUNGLE

When natives of British Guana jungles find the sun's rays too warm, they have only to break off the huge leaves of the umbrella tree and drape them over head and back. This photograph depicting their style in sunshades was made during a recent expedition, headed by Andre LaVarre, through the interior of Brazil and Guiana. In the background of the picture, the Kaieteur Falls, a wonder of nature seliom viewed by white meningh over a precipice 741 feet high, which is four times the height of Niagara Falls.



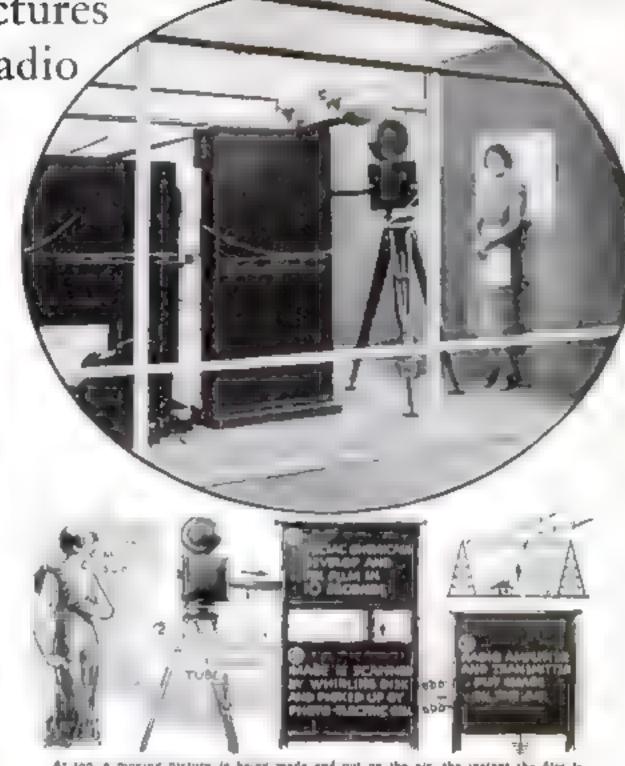
LEAD FED TO NEW PENCIL

Merely pressing down the cap of a new mechanical pencil while grasping the lower part with the fingers, instantly provides the uses with a fresh writing point. Each stroke of the cap operates an ingenious set of jaws that advance the lead the proper amount and then hold it firmly in place. A part of the pencil illustrated here has been

cut away to show this interior mechanism. The pencil holds four feet of lead. Movie-Film Pictures

Broadcast by Radio

RANSMITTING motion pictures by radio ten seconds after they have been made, is the achievement of a new form of television machine developed by German engineers. The results are described as superior to those of direct television since it is easier to illuminate the film than the original subject with the high intensity required for radio transmission of the image. Exposed film from the camera which continuously through a lightproof tube of a developing chamber where it races through special chemicals that almost instandly develop and fix the image. While the film is still wet, it passes before a photo-electric cell. With he aid of a powerful lamp and a scanning disk, the image is dissected so that a transmitter connected with the cell can put it on the air. While the film is a "negative," showing black as white and vice versa, it is reversed in transmission by a simple electrical hook-up, so that the image finally appears in its correct values of light and shade. Experiments indicate the new style of "delayed television" is to ada table to deficult lighting cord tions that even night street scenes may be transmitted. In a further renoement of the process, its originators are seeking to perfect a way of stripping the used mages from the film and re-sensitizing It so that It can be fed back to the camera and used over again in an endless cycle This would not only reduce expense but Would also permit the use of extra tensitive photographic emuisions that keep for only a short time. The present apparatus can be carried from one place to another on a small truck



At top a moving picture is being made and put on the air the instant the film in developed. This new process of delayed television is fully explained in the all untraction

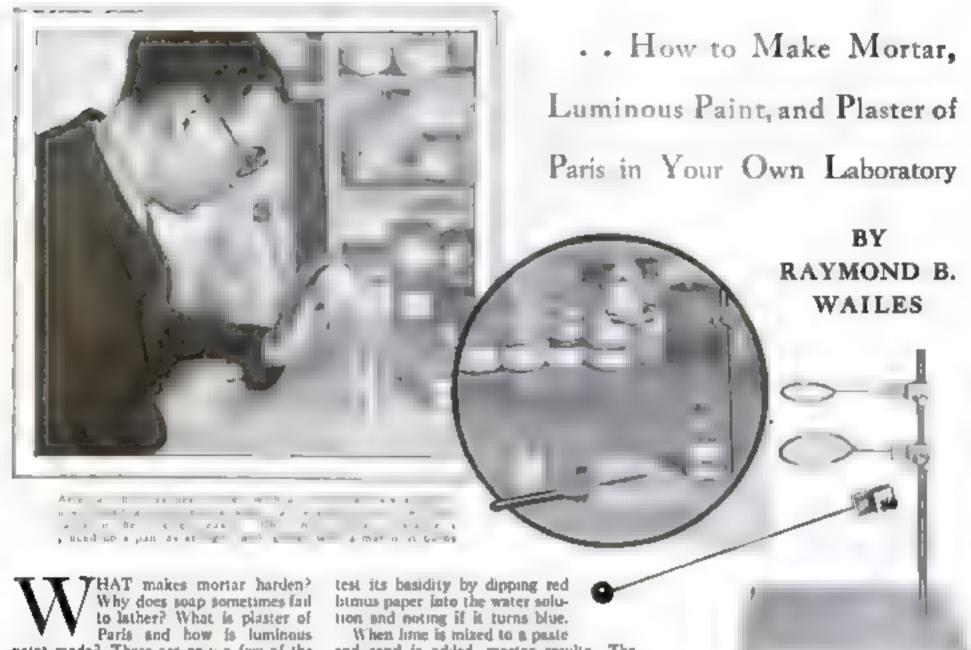
New Air Liner to Cut Transcontinental Flying Time



New streaml and plane, built for trunkcontinental activities, has cutractable landing wheels and twin matera capable of developing 1,400 horsepower. Its well-equipped cabin futurables accommodation for twelve passengers

THE newest type of air liner for transcontinental service will be operated by Transcontinental & Western Air Inc., on the fastest regalar schedule in the world Thu all-meta. Douglas machine carries twelve passengers in its luxurious cabin, which with the rest of the liner, incorporates the most advanced design in streamlining Retractable landing wheels fold into the wings when the craft is in flight. Twin motors, equipped with superchargers, develop a total of 1,400 borsepower to propel the big craft During the next few months a large number of the new planes will be put in service. The photograph shows the one now ready to be placed in service.

Home Tests with Calcium



paint made? These are only a few of the puestions that are answered for you when you experiment with calcium

Although calcium in its free metallic form is not common, its many compounds are known to us all. Marble is a combination of calcium and carbon, glass contains calcium combined with oxygen, and in the building trades we find calcium in cements and mortars. Even the bones in our bodies contain a form of this inter-

esting and important chemical. In the case of mortae the compound of calcium is derived from lime (calcium oxide) made (com a natural product called limestone. As an introduction to calcium you can make some lime in your home laboratory by heating marble chips (calcium carbonate). Place the chips in a porcelain crucible supported over a gas hurner. The heat will drive off the

carbon-droxide gas in the marble and lime. or calcium oxide, will be left behind. This is called quicklime.

By adding water to the time, you can change it to calcium hydrouade, or slaked lime. This mildly basic substance is sometimes referred to us in ik of lime while the clear calcium-hydroxide solution is known as lime water

You also can prepare small amounts of lime by heating syster shells or eggshells. In your experiments with hose you can

and sand is added, mortar results. The hardening of mortar is merely a reversal of the process used to produce it. In making the original lime, solid calcium carbonate is beated to drive off the carbon-dioxide gas. In setting, the carbon droxide slowly returns to the lime (calcours oxide) and reconverts it into calcium carbonate.

This changing back to its original state however, often requires many years.

Although mortar may be hard to the touch the day after it is laid, actually it requires some len or twenty years completely to change to its solid state

Plaster of Paris, another compound familiar to the building trade, also depends on the property of a calcium compound in setting. It is made by heating calcium sulphate, known in its natural state as gypsum, to a temper-

ature shehtly higher than that of boiling water. This heating draves off the mostture. When the resultant powder is mixed with water, it hardens in a very short time, the water uniting with the calcium sulphate to form hard hydrated calcium

If plaster of Pans is heated to a higher temperature, its time of setting can be lengthened. The home chemist can demonstrate this by comparing the seiting time of ordinary plaster of Paris and

Automobile fender guides, like the one shows above can be best around pipes of d Secont diameters, to make y ngs of Various a sea which, when artached to an up-

plaster of Paris heated to a high temperature over a gas burner in a crucible or the friction top of a tin can. Plaster of this type is said to be "dead burned."

BY COMBINING calcium with sulphar, the amateur chemist can make a mysterious luminous substance. After being exposed for a short period to a bright light, it will continue to glow when it is viewed in the dark.

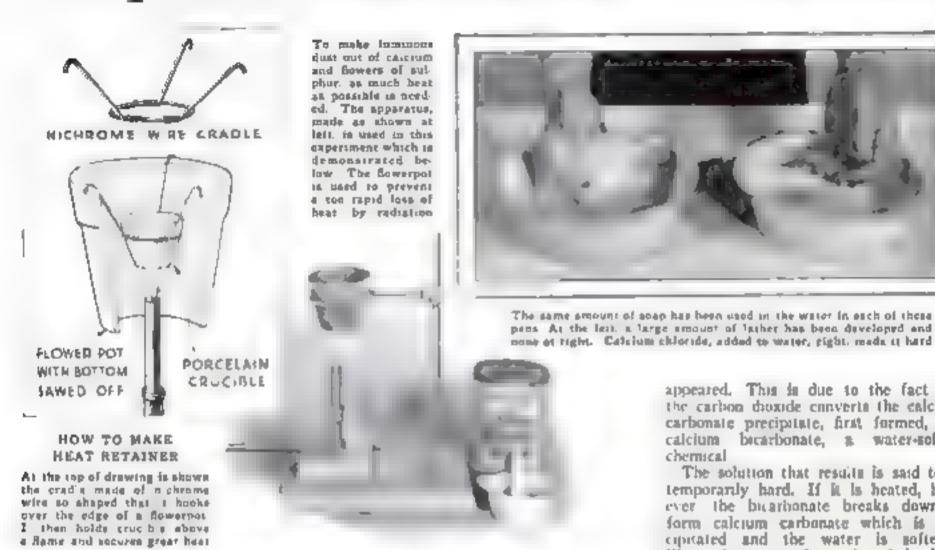
The calcium for this experiment can be obtained from oyster shells. First heat the shells in a small porcelam or clay crucible over a burner and discard the darker portions of the cold residue. Then after powdering the lighter chunks, mix them with about twice their volume of flowers of sulphur, and place the mixture m a small porceluin crucible having a cover. Heat the crucible for about half an hour As some of the suphur burns. the experiment should be performed in a well-ventilated room or out of doors,

When the heated mass has cooled, expose it to the sun ight for a short time and then take it 10to a dark room. The musture will give off a weird glow. If you fail to obtain the luminous effect, it will



Martin made of time band and coment is used

Explain Industrial Processes



he because the compound was not heated sufficiently to combine the nulphur and calcium to form the calcium sulphide

To obtain a high temperature with an ordinary burner and avoid radiation losses, you can arrange the flowerpot oven shown in the illustration. Cut the bottom from a small flowerpot with a back saw, make a basket out of lengths of nichrome wire to support the crucible, and insert the crucible. The flowerpot can be supported on a convenient ring stand. If desired, the clay bowl of a bubble pipe can be used in place of a porcelain crucible.

Another luminous compound can be made by mixing 100 grams (less than eight tablespoons) of caccium carbonale, or precipitated chalk, two grams (about one half tenspoon) of themscally pure sodium curbonate, thirty grams (two tablespoons) of sulphur, and two tenths of a gram (pinch) each of salt and bismuth nitrate. Healing over a gas burner combines the calcium carbonate and sulphur to form calcium sulphide while the sodium carbonate and salt act as a flux

Pleater used on nitrate serves as we is to another calcium product. It tets quickly but requires



and the bismuth an exciter

In our experiments with carbon dioxide (P.S.M. Aug. '32, p. 60), we found that the gas could be made by adding muniatic acid to marble chaps. After heating the acid and the marble, a thick, syrupy solution of calcium chloride resulted. This same solution diluted with water can be used to illustrate the properties of bard water

Hard water, as you have no doubt found, will not lather well unless a large quantity of soap is used. This is due to

the fact that the water contains certain chemicals that combine with the soap to form a precipitate

To show this experimentally drop a piece of calcium chiaride about the size of a pea or pour some of the calmam chloride solution into a pint of soft water. After the chemical has dissolved you will find it difficult to obtain a lather until a large amount of soap is used. For comparison, lather your soap in a pint of unireated water

Examine the treated hard water carefully You will note that a white precipitate is formed when the soap is added. As soon as the soap reacts with all of the calcium chloride in the water, however, suds will start to appear. It is the need for a large quantity of soap that makes hard water wasteful.

It is possible to treat hard water chemically to remove the hardening compound and make it soft. In cases where calcium chloride is the offending chemical in the water, sodium carbonate (soda ash. sal. soda, or washing soda) can be added to precipitate the calcium carbonate.

Other compounds of calcium may cause water to be hard. For example, take some lime water and bubble carbon dioxide into it by blowing through a straw or glass tube. At first, a white precipitate of calcium carbonate will form. Continue to blow through the tube and eventually the precipitate will disappear as quickly as it

appeared. This is due to the fact that the carbon dioxide converts the calciumcarbonate precipitate, first formed, into calcium becarbonate, a water-roluble

The solution that results is said to be temporarily hard. If it is heated, however the bicarbonate breaks down to form calcium carbonate which is precipitated and the water is softened Water that cannot be made soft by heating is called permanently hard.

Inspect the inside of your kitchen water kettle. If the sides and bottom are coated with a hard scale it shows that the water used is more or less hard. In boiling the water the calcium carbonate precipitated forms a "fue" or brittle scale on the sur-

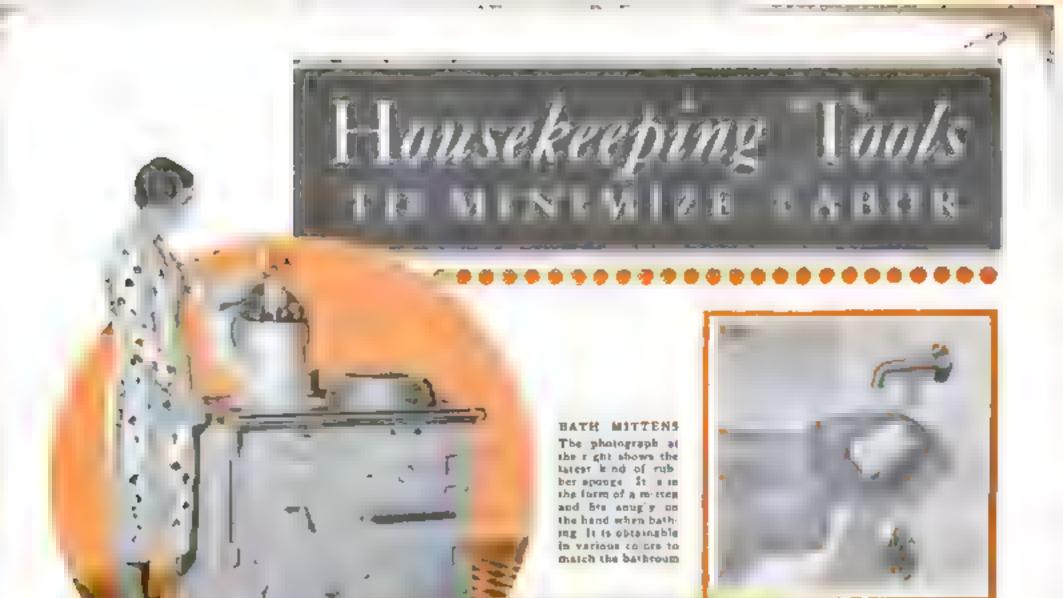
face of the metal. This same action is present in steam boilers supplied with hard water Being a poor conductor of heat, the calcium carbonate contong lowers the efficiency of the builer For this reason lodustrial companies located where only hard water can be obtained often treat the water chemically before it is used in the boiler.



dow panes are held in place, couts no a form of colcinio curbunite

By making use of a curious property of calcium acetate, the home experimenter can prepare a novel form of solid alcohol similar to the juded substance often referred to as "canned heat." The calcium acetate is made up as a saturated solution by adding the chemical to water until the solution will dissolve no more of the solid. One volume of this sociation is added to nine parts of denatured alcohol

Immediately, a grayish-white fellylike precipitate will be formed. Reaching an almost solid condition, it will remain in the mixing beaker even when the container is inverted. By cutting around the sides with a knife, loosen the mass and place it on the flat lin top of a can or bottle. Bring a lighted match near its upper surface and you will note that the jellied substance will burn with the colorless flame characteristic of alcohol.



UP-TO-DATE COAL STOVE Here a madpro cost range. It is so parfec y new stad that you can rest your hand any place on I bu un the cook ng plates. Coul to feel to it automatica y and it hurns only a ght pounds a day. It has two evens, one thermustation y controlled for baking the other wasts jacksten to keep the temparature under the boting point. Het water to ave able from a tap at the from Dreft is seguinted by the saver at aft. Het" and "madeum" cooking places are provided with the modern range

TO TIME ROOF The new egg coaler at the air a of .opper and resumb se a double bas er Cold Water is poured in haight indicated by th sa rings marked hard. "madaums, and "soft" depending on how you like your eggs. The eggs are placed in cold water in the cower per and a med am Rama is used. White eggs are bo led, the ch ckup whist as



PUMP BROOM

Where no electric surrent as evalable the device at feft mabes a satisfactory substitute for a vacuum the plunger up and down suchs the dust into the bag at the rop. This or casely suppoved



SINK DRAINSTRAINER

The appliance shown above prevents refuse from washlog down the solt drain Ir also acts as a stopper when the bandle is turned It is easily dired out so that the dra a and its connection p pen can be kept coner

TOASTER COMPARTMENT

A new gas range has a recess in the back in which a gas or electric toaster may be placed. When the touster is not assailed, the compartment may be used for avoring amaid kitchen atmosily



4 -----



How Stars Are Measured



A finisher button in used to find the number of terms I ght bulbs of versous even will finish per minute. When this is known, their relative prength can be judged reads y as any distance.

thinks of the brightest fixed stars in the sky as the nearest and the fairtest as the farthest away. Yet the nearest star to our solar system, Fran-ma Centauri, needs a telescope to see if while Sprius, the brightest, is twice as many aght, years away.

A simple experiment with three electric bulbs, representing stars, will illustrate the fact that apparent brightness is

no true measure of distance

If hubs of fifteen, twenty-five and fifty watta are set up on three standing lamps in a long, dark half or corndor, they can be arranged at intervals so that the bubs will all appear to be of the same brilliance.

If the fifteen-watt but is twenty feet from the eye, the twenty-five-watt but will need to be twenty-five and three quarters feet away, and the fifty-watt thirtysix and two fifths feet distant.

If the lamps were arranged at these intervals in your absence and you were called in to look at each through a paper tube and pick out their relative brilliance, you could not do it

But after performing a little experiment with a common flasher button, such as is used to make Christmas-tree lamps and store-window signs flash on and off regularly, you could tell which butb was brightest.

Place a slow flasher button in any lamp socket and then screw in your three hulbs one after the other airming the number of flashes that each lamp makes in a minute. In repeated tests made by the writer, be found that the fifteen-wait bulb averaged twenty-one flashes, the twenty-five-wait

eighteen flashes, and the fifty-watt surteen flashes per minute. The varying speeds use due to the different amount of heat

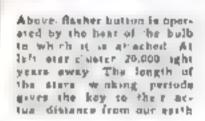
developed by the various lamps.

If each of the three lamps in the dark hall is then screwed in over a slow flasher button, you would no longer be deceived about their bulliance, no matter how near or how far away the lamps were placed by counting the number of flashes per nimite by your watch, you could unerraintly determine the strength of each bulb, no matter how bright or dan each appeared to be.

This little trick illustrates beautifully the way in which astronomers recently have calculated the actual brightness of a certain class of stars known as Cepheid variables.

These stars are suns that have reached a point in their lives where they pulsate regularly from bright to dim and back again, just as the stronger electric bulb

Experiments with Three Light Bulbs and a Flasher Button Show Method Used to Find Distance of Winking Suns from Our Earth



flashes slower on the flasher button, so an actually brighter, hoter star goes through its cycles from hight to dam and back gain more slowly than a less hot star.

Accordingly the astronomers have classmed the brightness of these remarkable stars as those that require five, len or twelve days to wink, just as we classified and identified our electric builts by the number of flashes per minute

In the same way, after the period of a variable star is carefully observed, its actual brightness is known. It only remains then to determine, with accurate light-measuring instruments, how much less bright it appears to be, in order to figure out how far away it actually is.

A parallel example, taken from our three light bulbs, will make this process clear

If our fifty-watt bulb is placed 100 feet away, it will be only one-fourth as bright as at fifty feet. In accordance with the law that brightness varies inversely with square of the light's distance from the observer. One hundred feet is twice as far as fifty feet. The square of two is four, and the inverse of four is one fourth.

By discovering that the bright-dim penod of the variables represents their actual degree of heat and brightness, astronomers have now gained a far more accurate yardstick for measuring the universe than they have ever possessed before.

New Stations Easily Found

LOCAL TESTS GIVE DIAL READINGS THAT WILL HELP DX FANS MAKE ACCURATE LOG



Pine y graduated dia that aggists decemen in accurately logging all their distant sections

ECEIVER data marked with arbitrary scales that bear no relation to meters or kilocycles often cause the amaleur trouble when he attempts to find a new station. However, by employing a simple trick of proportion, he can read his "O to 100" scale with greater occuracy than one marked in wave lengths or frequencies.

Every local station carefully logged increases the case with which new stations can be found. After a number of stations have been spotted, it is an easy matter to adjust the dial to a calculated pe nt and wait for the distant station to

For instance, suppose in local tests a 600-k-locycle station is located at eightythree on the dial and a 660-kilocycle station comes in at seventy-three. Stations on the 630-kilocycle band then will be found halfway between the two at seventy-eight. Using a similar proportion, other unknown stations pround the same frequency can be accurately located.

Of course, the error in the unknown setting will be greater when the two known stations are spread far aport on the dal. For this reason, it is best to locate as many locals as possible and use the dial readings for adjacent stations for

the calculation,

To assist amateurs who take pride in the accuracy of their DX logging a microvermer dial is available. Resembling the vernier reading scale on a micrometer, a stationary set of ten divisions remning from the left of the pointer makes it posten in a cell is necessary only to decide which mark on the vernier scale matches up with a division on the dial to obtain he fractional de-

This dial also is equipped with a Unique type of drive that can be adjusted to any speed within a certain tange Turn'ng a small lever cu ren ric with the main dial knob a justs 4 variable friction drive that varies the turning speed of the main-





Small pares con be hald in the control of the of so dering wire as a snown shove and at art,

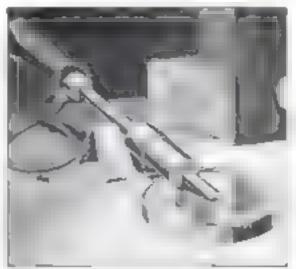
Solder Wire Puts Small Parts in Place

A/HEN you find it difficult to place a nut, a bolt, or some other small part in the depths of the radio you are building or repairing, you can turn to your roll of solder wire for a solution

For instance, if you want to start a rut on the threads of a bolt located in an out-of-the-way corner, you may find that your fingers are too fat or too short. Simply clip a convenient length of wire from your solder roll, lay one end of it across

the top face of the nut, and tap it with a bammer. The soft, pliant soider will be moided around the nut and hold it tightly. In the case of a machine screw, the soider wire is imbedded in the slot

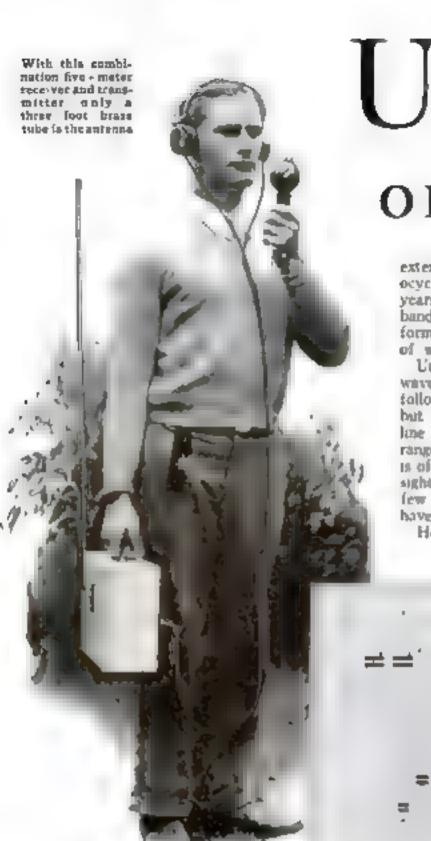
If the part is to be placed under a transformer or some other projection the solder wire can be bent into any shape or curve to reach around the corners. When the Job is completed a quick jeck will free the wire,-E, P B.



Melted resin placed in shallow pan can be med to keep the point of soldering itou bright

Melted Resin Keeps Your Soldering Iron Clean

NEXT to patience, cleanliness is the secret of neatry soldered juints. For this reason, a shallow pan bent from sheet tip and filled with resin will form a valuable addition to your soldering kit, By resting the tip of your hot iron on the resin during a soldering job, you can keep at clean and bright and free of any troublesome axides. Simply melt the resenover a gas flame, pour it in the pan (the friction top of a tip can will serve), and allow it to harden. In use, place the resin pad in front of your iron rest and tip the from so the point rests in the resin.—D B.



Ultra-Short-

OPENS NEW FIELD

extending from 1,715 to 14,000 kilocycles. During the past few years, however, the five-meter band has gained in popularity, forming the basis of a new group of waves of greater (requencies.

Unlike the longer broadcast waves, five-meter signals do not follow the curvature of the earth but like light, travel along the line of sight. For this reason, the range of a 56,000 kilocycle outfit is often referred to as the line-of-sight range. Up to the present, few long distance transmissions have been made.

However, it is in short-distance

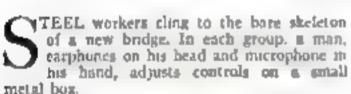
work that the five-meter band comes to the fore. It has few of the handscaps of the longer waves—static is less noticeable, fading a rarity, and light battery equipment practical since little power is required. For the amateur, a five-meter phone is ideal for short-distance messages.

Unfortunately, the make-up of a regular abort-wave receiver will not allow it to break in on the ultra-short waves. For the higher frequencies, a super-regenerative circuit must be used. Such a circuit is shown on the opposite page, By studying it, you can gain some idea of the arrangement.

Designed especially for the experimenter, the circuit consists of three tubes

(27s) rigged as a detector, an oscillator, and an amplifier, and an antenna that allows the set to be used over a wide range of frequencies. Tuning is accomplished by shortening or engineering a miniature antenna rigged in the

Ar left, diagram for the five moter trains to ver. Three type 30 tubes are used in the compactness of the character for an area of the character for the rear of the cabinet. This is connected from an end to metal cabinet.



John Carr

Hundreds of yards separate the engineers from the riveting gangs. Half the span stretches between the cablemen and their ground crews. Yet orders are given and received with the certainty and case of the telephone.

Such is the part ultra-short-wave radio soon will play in the construction of budges. Already tests have been made and circuits devised for portable five-meter radio relephone sets that can be carried into the field on any kind of construction job.

But engineers and steel companies are not the only ones who have found uses for the nitra-short waves. New fields have been opened for the experimenter. Licensed amateurs are now turning to the shorter five-meter band for new thrills and possibilities.

The ultra-short waves are just what the name implies. Until recently, they were considered useless. Radio consisted mainly of two general divisions, the broadcast band ranging from 550 to 1,500 kilocycles and the regular short waves



Wave Radio

TO AMATEURS

shape of a V. By means of a knob and a spring to take up the slack, the two legs of the antenna can be twisted or untwisted to vary the effective length of the wires. The longer the two legs of the V, the longer will be the wave length received.

In arranging the antenna, connect the apex of the V through a cuited metal spring to the control knob and the two out spread ends to two binding posts placed about eight or nine inches apart. The wires in their untwisted position should stretch out at least two feet.

As can be seen from the diagram, the spex of the V-shaped antenna is connected to the interrupting osculator coupling cod. The two inner ends lead to the plate and grid circuits of the detector tube

In winding the inductance coils, for the interrupting oscillator, they should be arranged so that the coupling can be varied. Two coils that can be moved closer together or farther apart wilserve in an experimental outfit

To operate the receiver, the 100,000 ohm resistance (A) and the variable condenser (B) are first adjusted to bring the set into oscillation. Actual tuting is accomplished by adjusting the antenna length and the variable condenser (C) in the antenna circuit

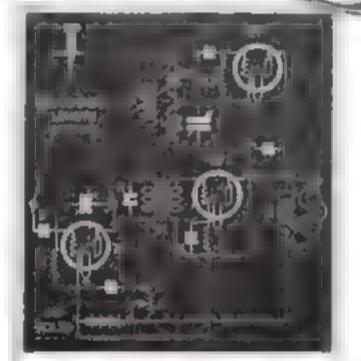
For portable work in the five-meter region, smaleum generally resort to a three-tube receiver and two-tube transmitter. Where maximum compactness is required, a combination receiver and transmitter circuit is used.

A trans-ceiver, an these five-meter portables are sometimes called, is shown in the photographs. Weighing attle more than an ordinary type-writer case, this phone station thes a three-foot length of brass tubing as an antenna. It can be seen projecting up from the rear of the cabinet. In tests, its power supply of three forty-five-volt B batteries has allowed clear telephone communication for line-of-sight distances up to one mile



To listed in on the ten-meter band, top the upper unit on your twenty-meter coil at the second or third turn and short out the rest

Front view of the trans-ceiver cabonet showing the panel arrangement. The awards at the extreme right changes situate from one for receiving to a phone t anomitter



1.151 OF FIRTS

With a few odd parts as listed above you can make an experimental ultra-short wave receiver that will cover a wide band of frequencies. This circuit operates on the adjustable length acteurs that is shown in the illustration below



One set of parts serves for both reteiver and transmitter. A flick of a switch located on the front panel quickly changes the circuit from one for receiving to one for transmitting It is combination sets of this general type that will find their way into toostruction work and police activities in uprestricted areas.

As a receiver the circuit is a three-tube super-regenerative. With the switch in the receiver position, these tubes become the detector, the low-frequency oscillator and the amplifier. When transmitting the detector becomes the power oscillator, the second tube is eliminated, and the audio amplifier serves as the modulator. With three tubes, a three-tube receiver and a two-tube transmitter are obtained.

On the front panel of its metal cabmet are four controls. A variable resistance, a knob for the tuning condenser, a filament awitch, and the change-over switch for converting the outfit into either transmitter or receiver. The microphone and the exrphones are plugged into jacks located directly below the tuning condenser

At the rear of the cabinet, a beavy-duty binding post supports the three-foot length of brass tubing that serves as the antenna. Inside the cabinet, directly behind the antenna terminal and connected to it through an insulated bushing, is the antenna coupling coil As shown in the photograph of the opened set, the antenna coil is so placed that the other inductances awing up in a direct line with it when the front of the cabinet is closed.

In use, the operator carrying the outfit places the earphones on his bead and carries the microphone in his hand. By merely operating the changeover switch, he then can carry on a two-way conversation with any other nearby trans-ceiver

The ten-meter band also opens an interesting field for the amateur experimenter. (Continued on page 102)

Duick Starts: ON COLD MORNINGS

UTSIDE the bouse, wintry winds howled, but in space of that beads of perspiration stood on Dan Nolan's forehead as he reached for the telephone.

"Give me Center 650," he beliowed after juggling the book impotiently

"Helio, Model Garage? That you Gus? Well this is Nolan up on Pine Road. I can't get my car started. What's that? Yeah, I've tried everything. It must be frozen or something."

Less than twenty minutes later, Gus-Wilson was standing in front of Nolan's

small one-car garage

Barned if I know what ails it." said Nolan as he opened the garage door and kicked a hand crank lying on the cement floor 'Can't even get a rise out of her with that. Wound her up till I was all in, without so much so a sputter"

Gus climbed into the car and leaned over the wheel. "Let a see what luck I have," he said as he pulled out the choke button and stepped on the starter

The motor grouned but failed to start "Your luck's no better than mine" Nolan observed. "I tell you she's cold Isn't there some way we can warm bec-

Gus lifted the bood and paked at the

motor with his stubby fingers

"Let's give her another try by band the veteron mechanic said finally, "You pull out the choke buttun and hold down the clutch pedal while I man the crank "

What's the idea of holding down the clutch?" put in Nolan as he took his

place in the driver's seat

"Makes it easier cranking" Gas exneutral gears through the cold grease in the transmission."

With Gus's brawny arm bearing on the crank, the motor seemed to turn easily. With almost the first twist, the engine coughed and sneezed and finally spun under its awa power

"Well I'll be hanged!" gasped Nolan "What did you do, hypnotize it

Gus chuckled as he ambled around to

the aide of the motor

"Come out here a minute" he said smiling, "and I'll show you something The main thing that was siving this motor was a loose set screw

"A loose set screw?" Nocan repeated. "Sure. Do you see that connection where the choke wire fastens to that arm on the carburetor? When I opened the hood, the set screw was gone and the



ByMARTIN BUNN

wire was hanging loose. Naturally the choke duln't work. All I had to do was pack the set screw out of the pan and put it back into place

"But the cold weather had something

to do with it, didn't it?"

'Oh, it probably made the motor a little stiff," agreed Cus. "But cold or no cold, that car would have started if the

choke had been working."

Gosh, sample as that, ch2" Nolan sighed. "In the winter I in always looking for trouble. I wish I could put some sort of a gadget on the car that would make it start easier on cold mornings."

It that's all that's bothering you there are plenty of track strachments said Coas. The latest one I we seen is a midget electric heater that fits right in the cooling system. It looks like one of those aquarium beaters. All you have to do is plug the connection cord that comes with it into the garage lighting circuit

"BUT extra appliances and knowing how to start a cold motor aren't the only things that make winter driving easser. It's little troubles like that loose choke rod that cause the headaches. If a

car's conditioned for colo weather 3.00 1 --

Year I know, put in Nolan with a grir "You're going to tell me I ought to cope my radia or with anti-freeze

That just keeps your motor from freezing," said Gus, "but it won't make cold-weather starting any easier. Fuel, sports, and oil are the important things in getting a motor started.

N THE first place, don't fool ground with cheap grades of gas. You may he able to get away with it in hot weather but they'll cause plenty of trouble in the winter

"It's the same way with spark plugs. Treat yourself to a new set every winter. A weak apark never started a cold motor. You ought to change them every ten thousand miles anyway. For the average driver that means at least twice a year winter and summer

"Give your ignition wires the once over Run your motor in the dark and watch for those dancing blue sparks that mean leaks and wasted power. From the looks of yours, I'd say you need a whole new set

"Then, there's the oil. When it's cold, heavy summer oil gets like so much molasses, Change (Continued on page 99)

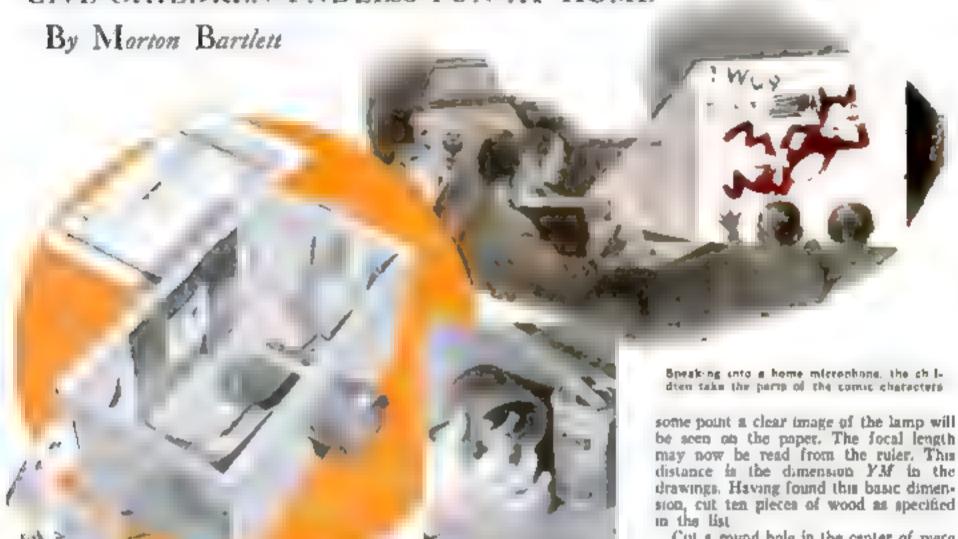
BETTER SHOP METHODS : IDEAS AND PROJECTS FOR THE HANDY MAN



MODEL MAKING: HOME WORKSHOP CHEMISTRY: THE SHIPSHAPE HOME

"Talkies" Comic-Strip

GIVE CHILDREN ENDLESS FUN AT HOME



The magic sentern a built of odd and ands. and her a magn fying or reading gloss as a lens. Two 100-watt lamps provide the light

NIQUE comic-strip "talkies" can be given in your own home at triffing cost. The pictures are thrown upon a screen by means of a simply made magic lantern, and the children speak the lines of the various characters through a home microphone connected to no ordinary radio receiving

The materials are listed on page 65 The first step is to make the lantern, Its width is equal to the focal length of the magnifying glass which will be the lens. Determine this by tucking a piece of paper against the walt 10 ft. from a lighted lamp. Hold a ruler perpendicular to the paper, and run the lens, perpendicular to the ruler, along the inch marks. At

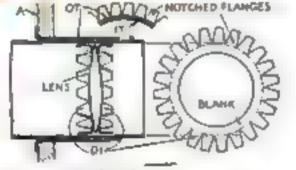
some point a clear image of the lamp will be seen on the paper. The focal length may now be read from the ruler. This distance in the dimension YM in the drawings. Having found this basic dimen-

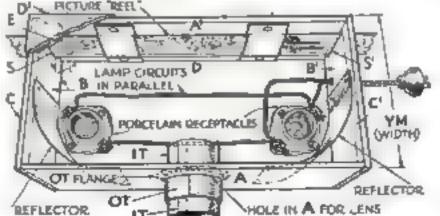
Cut a round bole in the center of piece A to receive the lens assembly Its diameler is the diameter of the lens, frame removed, plus the thickness of five pieces of fiber board.

Assemble pieces D, A, A^{\dagger} , B, B^{\dagger} . Make the saw cuts indicated by S and S1 flush with the back and 5 in. lung. C and C are now pailed, and pails are run through them into the two unsecured corners of B and B1. The top is left separate to al-

> low access to the interior. Ventilation need not be considered as plenty of air will circulate through the cracks

The reflectors are im cans. Remove tops and bottoms, sput up the sides, and spread open enough to fit them into the front corners of the lantern. Polish them (Continued on page 35)





Announcing A GREAT



nonprofit
organization
founded to help
you develop
your handicraft
hobbies and
make the most of
your increased
leisure under
the NRA

.. The National

T LAST the home crafts-men of the United States are to have their own national organization. It is to be a great mutual benefit association for those who follow any type of handicraft hobby. It will pay huge dividends—not in cash, but in good fellowship, in opportunities for learning better craftwork methods from experts, in the development of club and community projects, in the interchange of ideas, in actual savings through discounts on the purchase of materials, supplies, and plane, in giving access to special tools, machines, and equipment, in the strumulation that comes from having an official magazine and annual exhibitions, and in all the things that will make your own home workshop, no matter what you use it for, more pleasurable, more useful, and more profitable. In short, it is the best staution yet offered for the intelligent and

The new association is the National Homeworkshop Guild, Inc., with head-quarters in Rockford, Ill. It has been chartered in the State of Lihnois as a noncommercial organization. LeVern T, Ryder of Rockford, is the president, and E, Raymond DeLong, also of Rockford,

enjoyable use of the increased leisure in-

the secretary. With one exception, the members of the board of directors are also residents of that city. In addition to these officers, the Guild has an advisory council of most distinguished men, each one of whom is a notional leader in his own field. Its official magazine will be Popular Science Mostrilly.

"How can I join the Guild?" is probably the question you are already asking. This information, the necessary application blanks, and many facts that cannot be compressed into this article will be sent you from the national headquarters in Rockford if you will address a request to the Home Workshop Editor. Use the coupon at the end of this article and please inclose a large self-addressed, stamped envelope. The Guild has printed a reasonably large quantity of bulletins explaining how to start a local club, but there is no telling how quickly the supply will be exhausted, so don't delay

It may have strock you as currous that this splended movement should have origmated in Rockford. There is a very good reason for it. Rockford already has the largest and most successful home workshop club in the world. In October, 1932, invitations were sent to forty men known to have an interest in handicraft asking them to attend an organization meeting. forty-seven came. Mr. Ryder explained that a club was to be formed to exchange idean, conduct helpful programs and demonstrations, and to foster a wider in crest among he people of Rockford in the treful employment of spare time

The success of the club exceeded all expectations. It grew with amazing rapidity and now numbers more than 100 members from every walk of life. Outgrowing its original quarters, it became although with the Rockford Art Association and obtained the use of a large ball in an office building

Its activities have been exceedingly diverse and in all cases useful. At its bi-weekly meetings, members criticise and make suggestions for improving one another's completed projects; demonstrations of correct procedure in the use of hand and machine tools are given by members and professional craftsmen; members exchange tools; and those with exceptionally well-equipped shops frequently place their equipment at the disposal of other members.

Last Christmas the members of the club made several hundred toys for a local children's home. In February the club gave a handicraft exhibition, and more than that 5,000 visitors attended. Several unemployed members of the club have

NEW CRAFTSMAN'S CLUB

obtained jobs in local manufacturing plants because of exceptional technical skill demonstrated at the club meetings.

Among the members are lawvers doctors, merchants, foundrymen, machinists, toolmakers, accountant photographers, carpenters ministers, reporters, and painters. The output has covered practically everything that a home workshop can produce-turnture, models of ships engines, and houses, jeweiry bows and ar rows offe houses, aquariums speed boats, rowbon's, hisbing rods pewter wate, hammered copper brass and iron, handforged hunting knives and wood carving By working out production methods, the club found at a simple matter to make more than 100 doil cradles, hubbyhorses hasebad bats vanity cases, and puzzie boards for the orphanage

More ambitious still was their annual club project. They decided to make a drill press in which would be incorporated all the best ideas of the members including improvements not to be found in any commercial drill press. The ideas were criticized and worked over by several mechanical engineers who belong to the club. Patterns were then made under the supervision of a patternmaker; the cast-

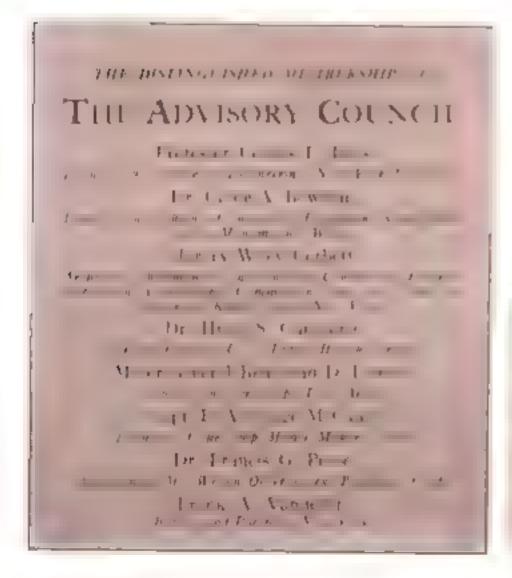
ings were prepared with the expert advice of several foundrymen, then the machinist members of the club divided the remainder of the work among them

Every meeting of the cash afters something tangible to the members. At one meeting an expert from a tool company may demonstrate how to care for and sharpen toois. At another meeting one of the more advanced members may give in structions in wood carving Decorative me al work, petternmaking the pouring of metal castings in the home workshop, furniture construction, the use of woodworking machinery operating an engine lathe, and similar topics are taken up. Each meeting is followed by he pfut discussions. The librarian of the cout is always in attendance and has available books, magazines, plans, and a complete set of catalogs of tools, machines equipment, and supplies, And in al. this there has been nothing in the least commercial -no effort to sell members merchandise or to influence them to buy certain brands. Prices are never mentioned at club meetings. Every club member, however, can obtain a discount for everything he buys for his home workshop merely by showing his membership card to the merchants in Rockford. Strange to say his vas nothing the club requested it was a voluntary arrangement suggested by the merchants themselves to show their appreciation of the advantages of the club and their desire to cooperate with it

Why should there not be such a club in every community in the United States? It is to make this possible that the new National Homeworkshop Guild has been formed Al. the presiminary panning has been done so that you can organize a local club with very but e difficulty. Talk it. over with your friends. If you do not know any others who are interested in the home workshop hobby, speak to your hardware dealer lumber merchant and point dealer. They will be only too gladto tell you who are regularly buying materrals for craf work Interest the newstaper editors and the ioral manual itahing teachers in the idea they will give you have of probable members and help with publicity and advice

All you need to join the National Guild is to organize a crab of not less than five members. Each member of such an affirmed group will hold an neividual card in the National Homeworkshop Guild. The Guild will also (Continued on page 89)

Homeworkshop Guild







A boat and do a huse made by members of the club at Ruckford II and es hibited at its first annual abow Fro thousand wanted the exhibited

Lighting Stunts for hristmas













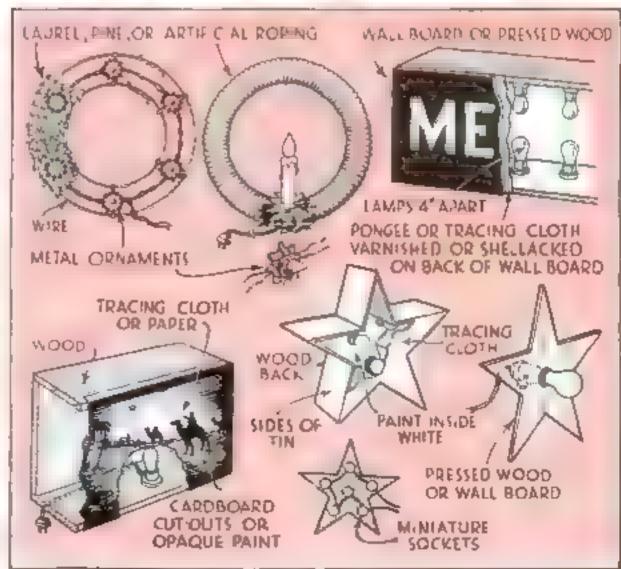


I get it a the way
to be a many
to be a many
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Ar 25 T e

Fyre or go are sees only



White of a continued on page 97)



How to prepare two kinds of illuminated wreaths, a greeting, stora, and pictorial accuse

THE SIMPLEST PLANS EVER DRAWN FOR BUILDING A BEAUTIFUL LITTLE

Clipper Ship Model

Sea Witch

BY DONALD W. CLARK

materials, page 62. Plane the piece absolutely aquare on all sides. Then mark the profiles of the decks, the how and the stern with a sharp-pointed pencil, and cut to these with a coping saw. True up with file and sandpaper. Next mark the top plan lines on the decks, which can be done easily by using cardboard templates Cut away the excess wood to these lines. Round the sides down to curve No. 6 on the body plan and begin to shape the bow and stern portions to the proper form I used no templates for this work, but relied on my eye After carefully carving the ends to correspond to the drawing and sanding the surface, your hud should resemble that marked "Step 3" in the sketches. The best time to drill the mast holes is after the decks have been out in-

in place with casein glue or a good bousehold cement Time can be saved in making the rudder if a wooden spoon of the kind sold with paper cups of ice cream

The deck houses, skylights, hatches, and other parts can be made of pine or whitewood. Cut them to size from three different thicknesses as in lauted - 1 g 3 .6 and is in -and said smooth. They should be glace in position on the decks on the center line. The fite roils can be made of the nor ordered houses of some y match st his glocal on as shown in the drawings. The howsprit

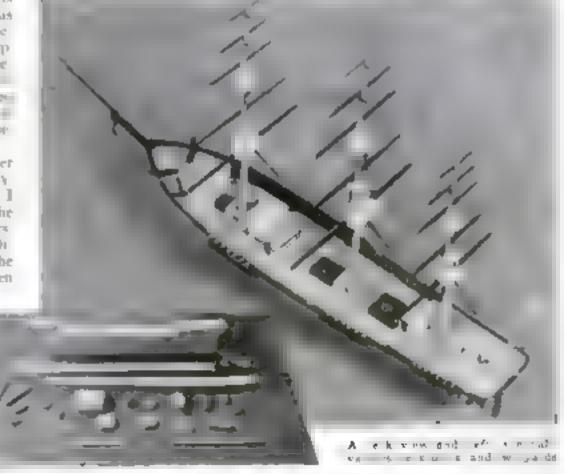
OST beautiful and popular of all shap a less in the American copper, yet beretotore it has always been one of the hardest to bood Beginners were scared to tackie a clapper shap and even experienced model makers thought twice before starting such an introde and examine To accompanying plans, however, have been so simplified that a beginner who has never attempted the work before will have little difficulty in making a fine highly decorative clipper model

Capt. E. Armitage McCann, who designs all the larger ship models described in Portrian Science Monthly supposed the sketches and information from which I worked and later checked the drawings and text. The model is of the Sea Butch, one of the fastest chippers. She was built at New York in 1846 by Smith and Dimon for Howland and Aspanwall and was used in the New York, West Coast, and China trade. Her best ten-

days' run was 2 664 miles on average of slightly more than 11 knots, and ber best day's run, 338 miles. She became a total loss when wrecked on a reci outside of Havana in 1856.

The relation of the model to the full size boat is about 1/20 in, equal 1 ft. The actual over-all dimensions of the model are 23 in, long and 6 in, high.

The bull can be made from a white pine block of the size given in the list of



spreader, heat sluds, galley pipe, bumpkins, and bounacle can also be made of match sticks. The 1/2-m. stock should be used for the catheads, capstan, hatches E and H, skylight L, and companion hatch M. The 3/16-in stock should be used to make the two lifeboots, batch J. and the steering gear unit. Cardboard will serve for the wheel, which should be mounted on a pin. The rim and spokes can be painted on, if so desired. The main deck house and house K should be sawed from the 14-in, stock. The latter should have its rear, lower corner removed so it will lap over the foreward edge of the poop deck

Draw out the bulworks on 1/32 in. thick cardboard and trum with a razor hade or sharp knife. Mark the positions of the six channels P and the notches to take the catheaus. You will note that the foreward lines of the bulwarks curve down, but when they are fitted to the hull, which requires them to be bent in and twisted at the same time, they will take an upward sweep, as seen from the side Make the channels and the stern piece

of the same material and glue in place The ladders can be made easily of the same stock by cutting parrow strips 1/16 in, wide and giving them together to form the steps as shown in one of the sketches.

The bowsprit should be made of 1/6 in. diameter lollypop sticks (or medical applicators may be used if available in the oestred size). The top member must be tapered down to 1 52 in, diameter at the tip. Hores drilled into the bull will support the bowsprit rigida. The bowsprit cap should be fiber, but the spreader is wood. Tapering is not difficult to do it a coarse worst mic is used forlowed with a tine file and sandpaper.

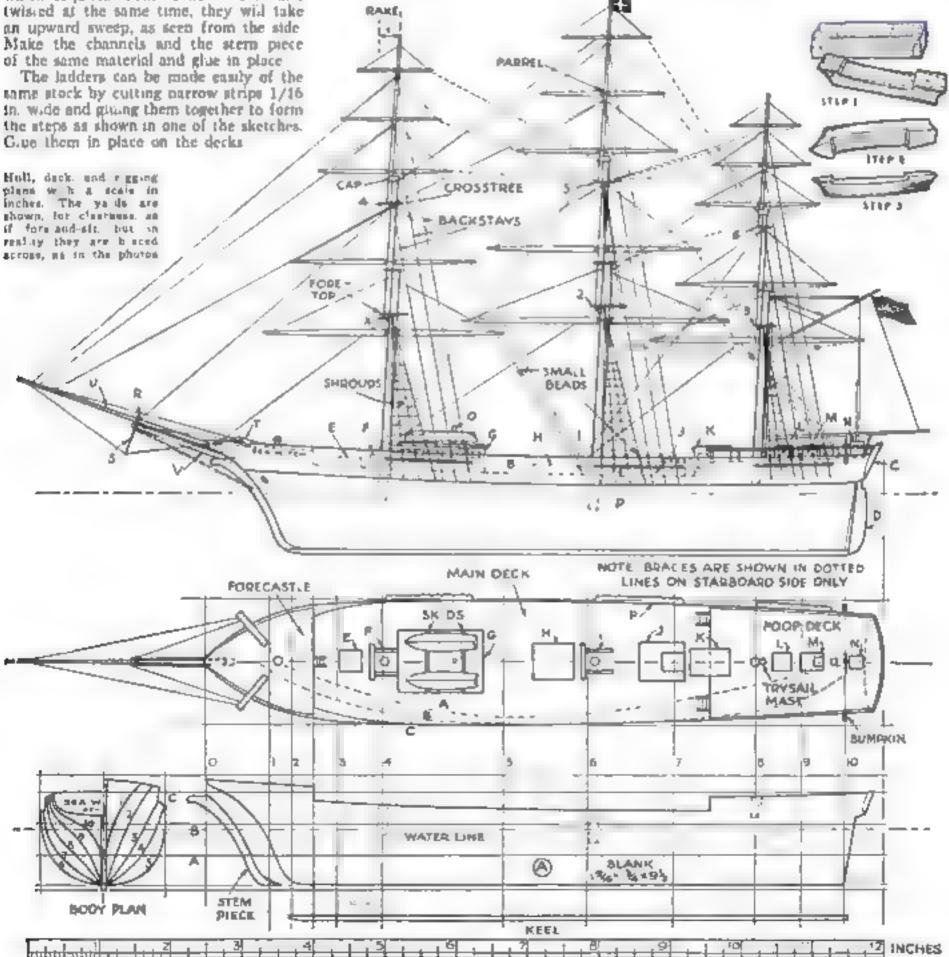
Work can now be started on the masts, crosstrees, and yards. This is a rather delicate job because of the small size of the parts. You will need sixteen or more 5k m. diameter follypop sticks to build up the masts and for the yards. For the lower-masts use the full diameter. The middle pieces should be reduced as shown, and the upper masts tapered. For the latter large match sticks will serve, but a harder wood is better. The lower yards are lollypop stocks, tapered carefully at

both ends. The upper yards are either apnlicators or match sticks. Use fiber for the crosstrees and caps. All of the parts of the masts should be bound with fine thread and glued together to form a unibefore they are set into the hull.

The trysail mast can be made from a follypop stick, as was done on the model shown, by reducing it with a coarse file The gaif and boom can be cut from ordinary match sucks. Fine were is suitable for fastening the yards to the masts. or they may be glued on, which is much quicker and will hold them in line,

It is important that all three masts line up perfectly. No matter how well a ship is rigged, it will not be plessing to the eye if the masts are set crooked.

The taffrails, if you wish to add them, can be made of wood or fiber and fastened to the poop deck and bulwarks with glue. They were purposely left off this model in keeping (Continued on page 82)



FREDERICK D. RYDER, JR., tells how to make a

Camera Record of your HOME



that your comers has an nagle of view of not more, but 45 or 50 and No trials er where you sand you can't take its he bing that a fra thou of the en re-

Professionals solve this problem by the use of wide angle lenger that include everything within 90 deg of more Fortunately however you can get in enough to make an attractive picture by carefully choosing your point of view. You can make up for the lack of a wide-angle outfit by taking two or more shots in each room if there happen to be a numher of features of construction of decora-

> tion that you wish to record

To show what I mean by this, I have taken the interior

view at the left above with regular professionel equipment Virtually every ttem in this particular living room is included in this view except, of course, the wall and comers directly behind the camera. The photograph at the right is a shot taken in the same room with an ordinary hand camera. The picture is just as attractive to look at and, with another shot of the corner where the davenport is (Contimued on page 70,

HE time to take a picture is at the first available opportunity. This is especially true of interior views of your own home. Just because you live

there and can take pictures whenever it happens to be convenient, the temptstion is to put it off from month to trough The result in all too many cases, is that the pictures are never takca at ai.

Why put it off any lunger? Start at once to take a series that will form a complete pictorial record of every part of your home. You don't need special photographic equipment. Your regular snapshot camera will do nicely

When you first start to take intetior views, you will encounter three main problems, but they are easily solved.

You bump into the first problem when you look into the finder to see what the parture is going to be like. You will find

Enter Your Best Prints in Our

\$50 PRIZE PHOTO CONTEST

With the new lights and supersensitive films now available, you can take fine indoor photographs. If you have never attempted it before, you are certain to be surprised at the results. It is easter than taking outdoor pictures. Just try it, and enter the best print or prints in our December contest. The prises are as follows:

FIRST PRIZE	425
SECOND PRIZE	15
THIRD PRIZE	5
FIVE PRIZES. \$1 mch	5
TOTAL	*50

Photographic contests usually have all sorts of conditions, but in this one the only thing that counts is the quality and general interest of the picture itself. The contest is open only to amateurs, but the developing and printing may be done by a professional.

Mail all entries to the Photographic Department, Popular Science Monthly, 381 Fourth Avenue, New York, not later than January 2, 1934, and mark them "December Photo Contest." It is not necessary to send the films. No prints will be returned unless a self addressed, stamped envelope is inclosed. The contest is open to all but employees of Popular Science Monthly and their families. In case of ties, each tying contextant will be awarded the prize tied for



1/25 second at 1,4,5, 3 PhotoGood lamps Kodak Super Sensitive Panehromatic Film

O tripods no long possel Now you can hold the camera in your hand and make anapahots anywhere indoors. You can catch your subjects in unposed, natural attitudes—get the pictures you have always wented.

Inexpensive Photoflood lamps acrowed in the regular room outlets provide the light. Or use the convenient Kodaffector, shown below. With two Photofloods it gives a light equivalent to that of 50 ordinary 100-watt lamps.

Use any Kodak with an f.6.3 or faster lens. You will find either of the two new models at the right ideal.

Load with Kodak Super Sensitive Panchromatic or, if you are using a miniature camera, with Kodak Panatomic Film. . . both these new high-speed films are now obtainable at your dealer's . . . and discover for yourself the thrill of indoor mapshots.

WITH THESE NEW LIGHTS, FAST FILMS



LEFT. The Ecdaffector makes two Photoficed lamps do the work of man. An efficient, insuperative beam lighting unit. Price, \$5.

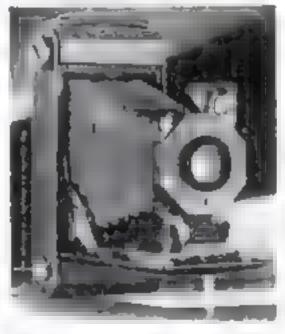
BELOW For indeer encyclote use Kodak "ft. ft. Pun" or the fine-grain. Kodak Panatomic Film. Both are extremely fast under electric light, fully coins nonseture. At your dealer's.

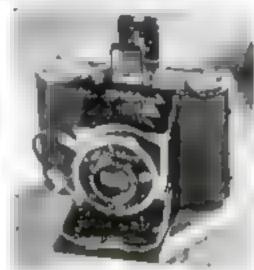


... WITH THESE NEW, FAST KODAKS

ROCAL VOLLENGA, area in action above, in an ideal camers for both indoor and outdoor shots. It is precision-built, compact, may in use

The model at the right has an /3.5 anastigment less, 8-speed Compar abutter, and ope-seed finder it takes 16 persons on a vest-pecket roll of Paratomic Prim, the new fine-grain film which makes beautiful enlargements. Price of /3.5 Vollende, 827 50. Vollende /4.5, with Pronta shotter and built-in self-times, \$15.50.





KODAK SIX-14 (left, aquipped with the famous /4.5 Kodak Anastigmet, has ample lens speed for indoor photography Beautifully designed, it is the world's most compact compact amove making 2 ½ 2 4 ½ pictures. Has Diodak abotter with speeds up to 1 reo second, and accordery abotter and focusing scales which are clearly visible in picture-taking position. Kodak Six-16, with /.4.5 lens, 810. With /.6.5 lens, 817.

If it am't an Eastman, it isn't a Kodak

175			_
- 34	. 21	- 8 2	-3
_	-		-

EASTMAN KODAK COMPANY, ROCHESTER, N. Y.

Please send me your latest camera catalog and booklet telling how to make indoor snapshots.

Name			
Street			
City	 	 State	

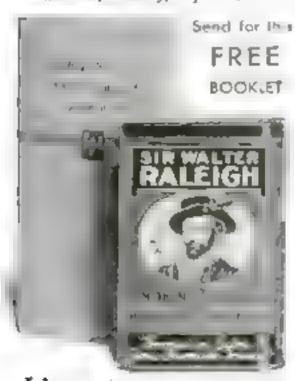
In a coma from that aroma

"FEMPORARY asphysiation from L bad tobacco in a bad pipe." That's what the doctor put in his notebook. And this remoraetal husband learned that it isn't only apples that

keep the doctor away.

Here's a prescription for keeping wives not only conscious, but happy with a pipe-smolong husband. Ask the tobacco store man for Ser Walter Raleigh Smoking Tobacco, It's that mild, flavorful blend of rare Kentucky Burleys that pleases husbands and wives alike. It's kept fresh in gold foil. When it's packed in a well-kept pipe, it will give you more satisfaction. than heavier tobacco, and you could smoke it in a submarine without upsetting the white mice.

Brown & Williamson Tobacco Corporation Lauwille, Kennicky, Dept. Y-312.



It's 15#-AND IT'S MILDER

A CAMERA RECORD OF YOUR HOME

Communed from page 65.

placed, would really form a better record of that end of the living room than is obtained in the one wide-angle view

incidentally, on interior view containing a kuman figure or even a dog or a cut is at least ten times as interesting as a picture that includes no animate object. Furthermore, it is easy enough to include yourseld in such pictures if no other member of the family happens to be available. With plenty of photoflood builts for light, the exposure can be kept short enough to be within the range of the automatic settings on the shut ter of any good camera, and an automatic

shatter release turns the track

The second difficulty is in picking the point of view. Here is where most begin-uers go wrong. Lacking a topod, they turn to a convenient chair, place the camera on it, and shoot. The result is a picture like the lower photograph on this page, a surt of dog't-eye view of the room. The ideal position for the camera lens is where your eye is located when you have finally selected the point from which the portion of the room you intend to take appears most attractive. Unfortunately, this high point of view, while most natural, cannot be used with the ordinary hand camera because you have to point the instrument downward to take in the features you want. This produces distortion and makes the walls of the room look as though they are falling outward All the vertical lines in the picture, which should be parallel, converge toward the bottom of the picture.

The solution is a compromise Place the camera as high as you can pet it and still keep it level while taking in the view you

want. Amateur tripods are built with this point in mind, and the best position usually will be found with the triped set just below its maximum height. The upper photograph thoug the same view as the lower one except that the carners has been rasted to the proper beight

In all cases remember that the farther away you can move the camera, the better will be the picture. Not only will you be able to take in more of the room, but the relatave size of objects at diferent distances from the lens w , appear more natural. This means that it is well to take auxantage of a door lea ling to another room Back through the door as fat as you can without barring the door frame cut off a part of the view you want

The third problem and a difficult one to some only t you work by davlight, is the matter of giving the proper exposure. The ideal "sureshot" lighting for interior views is to use either photoflood bulbs or photollash bulls. The latter are especially desirable if you add human interest to your pictures by including one or more members of your (amily

All interior views should be taken with as small a stop as conditions will permit. If there are no people or animale in the picture, stop down all the way and give a long esposure. With photoflood

bulbs for light and grown-ups in the picture, F/16 or U S. 16 (the two systems are the same at this point) is the best compromise. Assuraing that you are using modern firm such as venchrome, the exposure, with five photoflood bulbs in reflectors, when the average distance to objects is around 10 ft. and the room has medium-colored walls and hangings, well be about 5 seconds. That is fast enough for pactures that include grownups. With two bulbs in use, the exposure would be increased to 1255 seconds.

One photodash bulb, with the camera lens. at F 8, will give a su stactory exposure on

the allerage of mor year

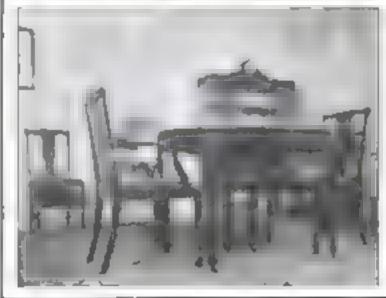
Here is a sum se rule for rules along indoor exposures or car ght that will give a printable regative hearly every time.

Set your lens at F 16. For a view with medium-colored walls and furnishings, with bright sunlight outside between he hours of none and birec, and two witnesses excrease the exposure four times. For very light-colored walls and fittings, cut the exposare in two. It viry dark double d. If selv one waters increase littly percent. For northern exposures as a sic-

As an example, suppose you had to photograph an across with abterdored walls only one window, and having northern exposure and the day was cloudy, you would calculate as follows: Cut the standard exposure of twenty accords to ten because of light walls, and add fifty percent bemisse of the single window, making fifteen. Double because of the northern expenses, making thirty, and multiply by four because of the

cloudy day mak no two minutes.



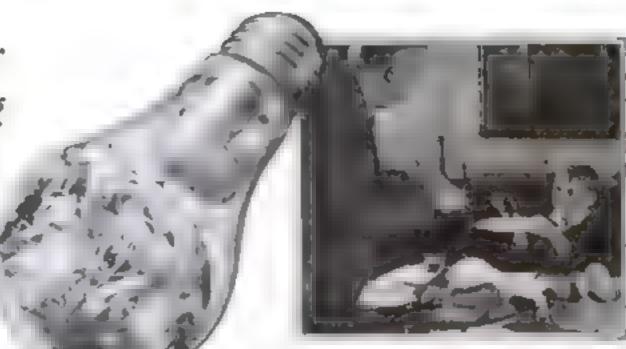


The upper view was taken with the camera at the correct beight, the lower photo resulted from placing it too low

For real Thanksgiving snapshots TRY THIS NEW LAMP

.. makes indoor picture-taking easy

only 15°C



depresentation by several day

ABOVE, SEE DIRECTIONS BELOW

Think of the thrill of snapping a picture of Grandpa carving the turkey . . . of Jerry digging into a plate heaped high with "trimmin's" . . . and of many other precious indoor scenes!

And all you need to make it EASY is some of the new G-E MAZDA Photoflash lamps!

These magic new 15c lamps make it as easy to take vivid, lively pictures indoors as snapshots in sunlight. They eliminate noise, smoke and dust, and can be operated from either light socket or batteries. For best results use them in the new style, inexpensive reflectors.

Photograph the joyous events of Thanksgiving and other occasions—with the new G-E MAZDA Photo-flash lamps. Your druggist or camera dealer has them. General Electric Co., Nela Park, Cleveland, Ohio.

FREE-Write for an interesting new booklet en INDOOR picture-taking





Set the camera for "time" and place on a table or triped from, if necessary. Then insert a G E M agina Photofiash lamp in the reflector. You do not need to got out room lights.



When ready to take the partners, open the commerce shutter, facts the lamp by pressing the reflector button and close the shutter. It is an easy as taking imaginate outdoors,

New Hints for Car Workers

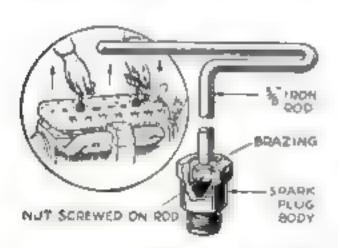


Ideas That Save Time and Trouble In Repairing Autos Submitted by Our Readers

Pressure-type garden aprayer can be used, as above 10 shoot lubricant into all parts of car

A battery cup, or ranged so shown, muselul obsert ng the rubber floor covering out of the way when you work on bettery

URING the months when your pressure-type garden sprayer lies idle, you can put it to good use orling your car's charate and springs Charged with a half-and-half mixture of crankcase drainings and kerosene it will form an excellent pressure offer Shooting the lubricant out in a fine spray, it will force the oil between even the tightest spring leaves and chassis parts, If your particular aprayer is fitted with a rubber seaung washer, replace it with one cut from leather as the oil soon will swell the cubber. Incidentally, putting the sprayer to that use will in no way injure it. As a matter of fact, the oil will tend to protect the tank from corrosion and rust during the fall and winter.-W. H.



Removing Cylinder Head

THE job of removing cylinder heads can be made less of a physical task by improvising the simple handles shown in the illustration. Made by fastening fifteen-inch lengths of three-eighths-inch diameter from rod to the bodies of discarded spark plugs, these sturdy handles can be acrewed quickly into the motor head. First remove the porcelain from the spark plug. Thread one end of the rod to take a nut insert the rod and the nut into the body of the plug, and braze over the top to hold the nut farmly in place. The outer end of the rod can be bent to form a convenient handle as suggested in the drawing.—E. W. B.

Trick for Gable Glamps

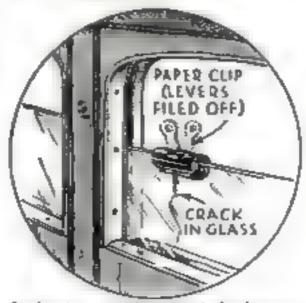


A cubbat washer around terminal post heeps cable competementicling AFTER trying all sorts of tricks to prevent the cable clamps on batteries from sticking to the battery terminals. I hit on the following idea that seems to work better than all the rest: First I cleaned the clamps

and terminals thoroughly. Then I selected a large rubber washer that was a tight fit for the terminal post, slipped it over the post forcing it down next to the terminal base, and fastened the cable clamp in place on top of it. So far the clamp has remained clean.—E. J. N.

For a Cracked Window

F THE window in your car's door cracks vertically, you can make a neat emergency repair by using a small paper clip of the steel-spring variety. Fasten the clip in place over the upper end of the crack as shown, shear off the two handles close to the spring, and file off any rough edges. The pressure of the clip will hold the broken edges together.—At C



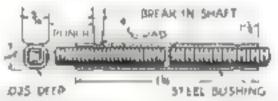
Steel-spring paper c'up comes in handy to repair, in an emergency, a window that is cracked

BATTERY

To Hold Floor Covering

WHEN you do work around a battery located under the floor boards, you will find a battery clip having a wire hook boated to it a very useful tool. The rubber floor covering that always persuate in getting in the way, can be held back merely by snapping the clip on one corner of the mat and looping the hook around the gear-shift lever or brake rod.—E. G.

Fixing Speedometer Shaft

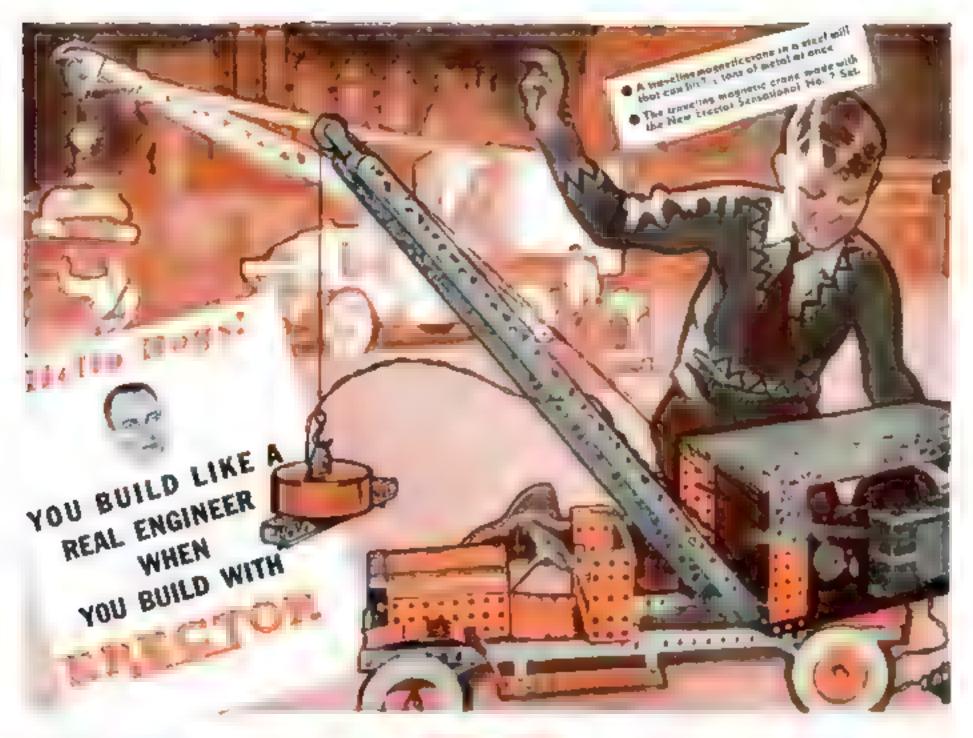


A greel bushing out to fit taugly, makes a good repair job when appendement about breaks

WHEN the shaft of your speedometer breaks, you can make a permanent repair by fastening the broken ends with a steel bushing or sleeve. If you can't find a piece of thin-waised steel tubing that will slip snugly over the shaft ends, drill a short piece of three-sixteenths-inch cold-rolled steel rod to be a tight fit. Insert the broken shaft ends into opposite ends of the bushing and, using a curved-tip punch, force the bushing wall into the shaft at four points about one-eighth-inch from each end to hold it in place and prevent at from twisting loose.—J. E. K

Gold-Weather Washing

IN FREEZING weather, many car owners find it bard to wash their cars in
the open without having the water freeze
on the body If you have a little radiator
glycerine on hand, add two parts of it to
every bundred parts of the water you
use. It will prevent the water from freezing even when the temperature is very
close to the zero mark—J L.



HOW would you like to be an automobile engineer and build a big motor truck? Put it together-piece by piece-with your own hands. How would you like to construct a great steam shovel, with a real electric motor - and make it work just like the ones you see on the highways? How would you like to build a drawbridge that actually opens and closes-a towering ship crane such as used in Uncle Sam's Navy Yards—a mighty housting engine-in seroplane-and dozens of other thrilling engineering marvels?

Does that sound like fun? I'll tell you, boys, being an engineer is the most exciting thing in the world. And that's just what you are when you have one of my New Erectors.

BIGGER AND BETTER THAN

EVER This year I completely re-designed and modernized Erector It's twice as much fun as ever before. You can make more realistic models. You can make them easier and quicker.

TUNE IN "Engineering Threils"

True stories about real engineers and their hair raining advectories to diagrag the Panama Canal, building bridges and skyscrapers.

WJZ Network-Sundays, 6:45 P.M.-E.S.T. Seclocal program listing.



THE NEW ERECTOR

Sensational No. 7 Set

Contains the powerful Gilbert zin-volt motor, all purpose gear box, girders, gears and other real engineering parts for building magnetic crane, fire engine, automatic elevator and over 160 action models.

Erector Sets start at \$1.00. Be ture to see the Famous No. 4-the "Super-6" Erector - and the Sensational No. 7.

My Great Erector Prize Contest— Free Automobile—Grand Total of

1,021 PRIZES!

Now I have another thrilling Erector event to tell you about. The most atopendous metas-model prize contest ever held. First prize is a free trip to the Panama Capal, or Boolder Dam or the Empire State Building or any other engineering project in the United States you would like to see. Second prize a brand new Chevrolet automobile. And over 1,000 other prizes.

■ I am positive every red blooded boy will want to be an Erector Engineer this year So right now, do these two things. First, mail the coupon below, and I'll see that you get my big illustrated "Look-Em-Over" Book and an entry blank for the prize contest. Then go to the nearest toy store and pick out the Erector you want. Take your Dad along. He Il want to share in the fun... And good luck in my big posse contest.

Your friend,

Cl Caller

FREE CLIP THE COUPON

Mr. A. C. Gilbert, The A. C. Gilbert Company, 381 Erector Square, New Haves, Conn.

Send me the big colored Erector "Look-Em-Over" Book and many blank for the Recetar prize contem-both free.

Address.

City _____State____

Genuine EVEREADY PRESTONE

The <u>same safe</u>, all-winter anti-freeze sold last year for \$4.45. Concentrated—not diluted or cheapened in any way.

Two minutes or your time in reading the facts on this page may save you many hours of driving-discomfort this winter. Do not wait until the first freezing day comes to decide the kind of anti-freeze you want. The economy and safety of your winter driving will depend upon how well you choose. It is important that you learn the facts now.

Economy plus safety

You know this about anti-freezes. There are two types—the "boil-away" kind and the "permanent" kind that is supposed to stay right on the job throughout the winter. Boil-away anti-freezes smell up the car. They are inflammable. They evaporate in warm weather, and leave your car unprotected against the next cold snap. Their one appeal in the past has been their low initial cost.

But today, at the new low price of \$2.95 per gallon, Eveready Prestone is within the reach of all. And, of course, in all-season cost it offers real economy. That's because one filling of Eveready Prestone gives you complete protection all season long. No replacements, no costly repairs for frozen engines, no rust, no worry about the protection in your radiator. It's there to stay!

Permanence plus rust protection

With Eveready Prestone you get this permanent anti-freeze protection without the penalty of a rust-clogged radiator and overheating.

Many so-called "just-as-good" anti-freezes are being offered. Some give protection for a limited time; others are immediately harmful to your car. To bring you the cold, scientific truth, "permanent" anti-freezes have been subjected to exhaustive tests—the most rigorous ever conducted.

For hundreds of hours, each product was run through an automobile cooling-system at a speed and engine-temperature exactly duplicating actual

driving conditions. Under this test Eveready Prestone was unchanged after 1000 grueling hours—still giving full protection not only against freezing, but against rust and corrosion. Other anti-freezes, in the same test, broke down and became definitely corrosive to the cooling-system in from 50 to 200 hours . . . developing "anti-freeze rust," a common cause of radiator clogging and overheating.



If, for example, your average driving speed on the road is 25 miles an hour, this test means that Eveready Prestone will protect your car for 25,000 miles of driving and upwards.

Do not confuse Everendy Prestone with either alcohol or glycerine

There is no other anti-freeze "the same as Eveready Prestone"... or anything like it. Eveready Prestone is a distinctive, patented product. It protects your car not only against freezing, but also against sust and corrosion in the cooling-system. Its use reduces the corrosive action of water on cast-iron 95%; on other metals of the cooling-system, 75%.

Eveready Prestone is approved by every carmanufacturer in America, as well as by all leading radiator makers.

Don't buy water when you can get it out of the spigot

Don't be fooled by "tricky" prices. Laboratory measurements show that many "permanent" anti-freezes are nearly half plain, ordinary water. Eveready Prestone is concentrated—all anti-freeze. Here's a little revealing arithmetic:

For a 1933 Plymouth

plus sale protection from runt and corrosion.

Read this guarantee

National Carbon Company Inc. specifically gus, antere that Everyady Prestance, if used according to directions, will protect the cooling-system of your car against frees, ug and clogging from cust formations for a full winter, also that it will not buil away, will not cause any damage to car finish, or to the metal or subber parts of the cooling-system, and that it will not look out at a cooling-system right enough to hold water.

At the new low price Everendy Prestone is the chapter and safest acti-freeze you can buy for all-winter protection against freezing and tust. Have it put in now. It won't evaporate, or heat up your motor With Everendy Prestone in the car, the enti-freeze question is off your mod for the entire winter.



NATIONAL CARBON COMPANY, INC.

General Offices New York, N Y

now 2115 a gallon



← This Studebaker (Comm. 73, '33) can be protected to 10° above zero with 1 gal. of Eveready Prestone at a cost of \$2.95.

This Oldsmobile (Model F33, 6, 133) can > be protected to zero with 1½ gals, of Eveready Prestone at a cost of \$4.45.

FINE test R DWN CAR DN THES CHART. If your our to not bested, per your dealer. He has a complete chart sharing every our made. The amounts of Economic Presions required, as shown here, do not allow for the capacitous of has motor heaters if you have a hot senter hanter, or if you need to perfect your each any forcer temperature, down to 60 halom seen, consult your douler



The important thing in buying an anti-freeze is to figure cost to a definite protection point, not the price per gallon. See how reasonably you can get all-winter protection against freezing and rust with Evercady Prestone. GALLONS OF EVEREADY PRESTONE NEEDED TO PROTECT TO THESE TEMPERATURES

GAR	MODEL	10	Zere	ph(qm	CAR	MODEL	10	Zero	10 below
Buick	32 at. 32; 41 at, 44	4,6	1	114	La Salia	340, 120; 343, 161	14	2	2 3
	40, 30, 32-66, "32	1	14	134		345, 132; 345-0, 133	1.54	24	214
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	R-80 II-90, 11 J5-J6-70, 14	3 Tab.	146	3	The same of the sa	6.46, '31, 960, '13	H.		116
	32-89, 32-49, '32	156	314	1		hao' ,33' ano' 3130' ,33	1	14	14
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	4-2, '31, 4-2, '32 4-4-1, '31	136	214	34		Spec B, Tem Ign. 23	119	114	2 4
		1.4				Amb. B. Twin Ign. '32	14	7	24
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	.11 '32, 33	14	3	114		£32, 0, 132, £33, 0, 133	114	134	156
Chrysler	6, 31-8-10-6, 53, 11	1	149	111					
	C.U. Cala, 31	15	146	2	Peokerd	Jack 7, 1003-4", TR	114	14	Z
	Imperial Conton, J3, 34	7	215	3		R26, 833, 731, 566, 782	1 a	314	2
De Seto	N 31 '32		154	14		45, '30; 845, '51; 15d, '31	5.11	2.4	216
	H. '31, '32 6, '33		150	16		1005-4, '3.5	249	3.14	4
					Planta-Arrow	54, 193, 836, 193	134	2	216
Dedge	h, '33	1	142	14		d, 52, 34, '32	214	3.36	34
	H. 33	14	149	2		1216, 1343, 1347 '83	244	34	3%
Koort	129, 139, 131, 133	14	15,	2				-	
Essat	6, 33	6.0	1	14	Physically	31, 33 Fhg. Power	,	116	14
Terroplane	0, '33	1.1	116	116		Six; De Late '33		14	1.5%
Ford	A. 126, 129, 130, 131, 132	L _a	1	14	Position	29, 21, 4, 22, 4, 21		156	136
	Van. 192. 39	139	2	214		8, 732	15,	2	235
Hudson	и. 110: и, 131, 132, 133	126	136	114	Studebaker	INet. 731; 82, 123	154	14	14
	88, 33	1	1.56	136		6, 32	100	1 1	115
Magraebile	H. C. 30; B. 31, 32	814	2%	2 1,		Diet. 8, 725, 6, 73	1 "	114	114
	18, 41, 33, 321 '31	1	159	110		Laste, R. 32; Com. 71, 713)	116	116
	226, 132, 326, 33	136	2	239		Phys. 8, 732	114	11,	24
	222, 10, 122, 133	136	146	24		42, 433	114	2	2 4

COST OF EVEREADY PRESTONE

14 gallon	 81.50	114 gallons		. \$3.72	2 gallone	\$5.90	23 ₄ gallons		SR. 12
a gallon	 2.22	11/2 gallons	-	4.45	214 gallons .	6.67	3 gallons .		8.85
1 gallon	 2.95	1% gallone		. 5.17	2½ gallons .	7.40	3 lá gallops	-	9.62

How many of your friends like the same things you do?

IKE many other good people you want to make this Christmas as merry and happy as the budget will allow

That's why we think we have a plausible, intelligent suggestion to make to you

Our suggestion is based principally on the fact that you read and, we hope, enjoy Popular Science Monthly For if you do, there are undoubtedly many among your friends who might feel the same way. Men, or boys, who may have picked up the magazine in your home, thumbed through it, sat down with it—and found a magazine they genuinely like. Something that gave them a stimulating bour or two—something different from the ordinary run of magazines.

But we don't have to tell you about Popular Science Monthly. Whether this is the first or bundredth time you've read it, you have by now a clear picture of its merits and its fascination for the alert-minded man who likes to know about the marvelous things science and invention are constantly contributing to the comfort of our daily lives.

Surely some of these friends would get the same "kick" out of Popular Science that you get. For very little money, then, you can be instrumental in bringing them

this pleasure—not just temporarily but all through the year

And here's something your pocketbook will be interested in. The regular subscription price of Popular Science Monthly is \$1.30 a year. For Holiday Gift. Subscriptions, though, it's only \$1.25—this reduced rate is our own Christmas gift to every reader who wants to send the magazine to his friends. Your own subscription or renewal may also be included at this price if you are ordering one or more Gift Subscriptions. If you include your renewal your present subscription will be continued for one year beyond its present expiration date. The first copy on each Gift. Subscription will come in time for Christmas. And we send to each friend on your Gift list an appropriate Gift Card in color. It will bear your name, and announce that Popular Science is coming all through the year as your gift.

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Knotted Cord Key Case

designs in any type of square-knot work

$\mathbf{B} \mathbf{y}$ KENNETH MURRAY

TINCE the time when Columbus is supposed to have bartered squareknot articles with natives of the West Indies, few have been the new ideas advanced for elaborating this type of handicraft, which has now become so popular. In making this knotted key case, however, a real departure has been introduced in carrying out various designs in bright cours there the method is undersoon, it will be found easy of opplies ton in any square-knot project In teed extra cords of contrasting colors may be started and ended anywhen without interfering with the regular order of knotving. Initials, borders, and designs of many kinds may be made

Required are twenty-three brown cords 60 in, long one yellow cord 36 in long one brown or black map fastener set and one 6-hook swivel key plate

Make two rows as shown in Fig. 2. Then proceed as in Fig. 3 and continue with each succeeding knot, excepting the last entirely across the piece. This will leave a upot of yellow cord in each knot forming the design. In knotting suc-ceeding rows, the yellow is worked into the knots directly under the second and twenty-first knots of the first row, to form a border around the edge of the key case

After the first row it will be necessary to hold the work on the edge of a table with pushpins, allowing the original filer cord to hang down at the sides. This is kept a part of the work by making a double half-hitch around it at each at a of the piece with the outside cord at every other row (see Fig. 4) When the work in 3 in long, bring the yellow cord ends back to the middle. They should cross inside a knot as in the small circle Apply a drop of cement, draw the knot up tight, and cut the yellow cord off short from the back. Make several more rows of knots; then bring the filler cord ends in from the sides, making tight halfhi, ches over them with the others. The row of batches will be growded, so but one turn can be made with some of the curds. A little cement should be applied and the ends of the cords cut off short with a razor blade.

The key plate and snap fastener are easily made fast with the tools illustrated. Take core to pass the rivets of the plate and posts for the fastener through the open centers between the square knots

This is the ninth in a series of articles on knot work. For other designs and methods see P. S. M., Nov., '32, p. 77, Mar., '33, p. 68, April p. 75, May p. 63, June p. 82, July p. 65, Sept. p. 65, and Oct. p. 67.



Rivets are inserted through the spaces by placing them over the end of a had set. Secure the fastener by using a piece of hardwood with a small hole which may be set over the apring. Tap the wood until spring and post are jouned. Then use a larger hole to clutch the top part

CONSTRUCTION KIT for Miniature Clipper Ship

POSTPAID COMPLETE \$1.50

(HRISTMAS is the time to take full auvan age o, the many remarkable con-A struction kits offered by the Popular Science Homecraft Gold This month's new kit, for example, contains all the materials for making a simpufied but beautiful little model of the famous American ellipper thip Sea Witch, and the price is only \$1.50. It would be an especially fine Christmas present, whether you actually constructed the model yourself and gave it away completor merely sent the kit to someone you think would like to take up the hobby of ship prouel making

The new clipper ship kit is marked J in the list below. It contains the hull block, sawed carefully to the approximate shape, and materials for the deck fittings, spars, and

reging Other ship models that are small, simple, and comparatively easy to assemble and therefore suitable for beginners are those marked F and H. The furniture kits Nos. 2 4, 5, and 6 are also so quickly assembled that anyone can make them of in time for Christmas Al. sits are accompanied by instrations or blue cints

A Wha hg ship maie, Wanderer All the taw nia criais-wood wire shing little chain. cel slock, and every hing but the paints, together with Islancions No. 151, 25, 153 and 154 and a boostet. The hull is 20 in long. So 90 AA. Same with hull lifts sawed careful-

ly to shape , D. Spanish galleon ship model, 24 in long. All the raw materials (except paints),

Blueprints Nos. 46 and 47, and a booklet 6.45 DD. Same with the two main hull blocks E. Battiebip model, U.S.S. Texas, J. ft. long. All the raw materials (except paints) texcept paints) for a mplified miniature modes 17 in one, and Brueprint No 264 100

G. Elizabethan galloon Revenge. All raw materials (except paints) for a model 25 in. long, and Bluepriots Nos. 206 to 200 . 6.75

GG Same with bull

B Cruser 1 S S Indiana poli A raw maverious (with chamch) for a simplified 12-in. model, and Blueprat No. 216 150

J. Clipper ship See Witch. All raw materials (except puints) for a simplified 12-m. model, with blueprint.....

No. 2. Solid mahogany tray-top table 23 in high with a 15 in diameter top. Ready to assemble, but without finishes 5.40

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XIT] contains uniterials for this beautiful little clipper ship

rack with one drawer, 19 5 in wide, 331/5 in high Ready to assemble and stain in-

No 6. Soud rock maple hutterly table. top 19 by 22 (a., height 22% in. Ready to assemble and stain insuded 6.90

North: In addition to these construction kits, Porviou Science Monthly offers blueprints alone for many projects. A complete or report of the and persuit or onlyour who incluses a stamped enverope.



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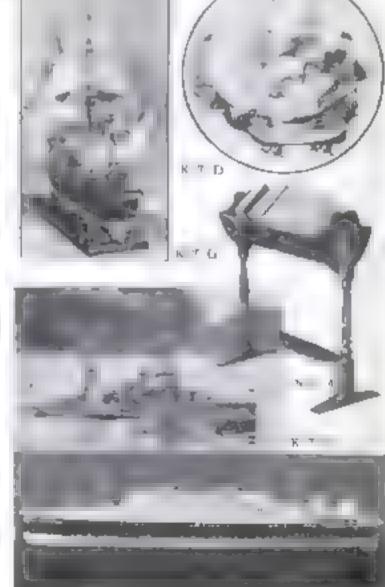
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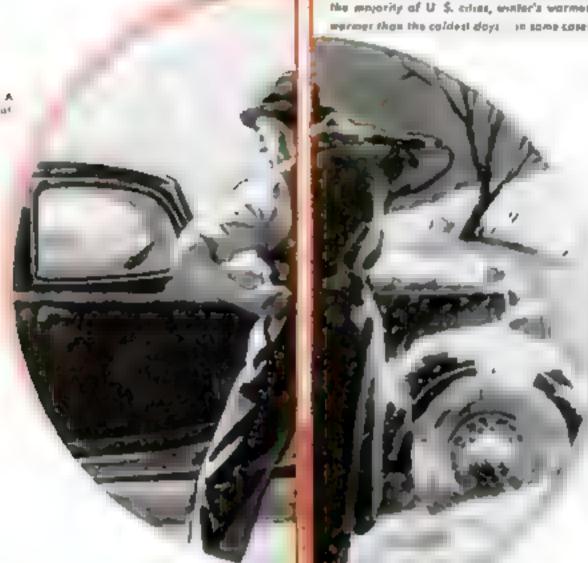
KtT P-Materials for 12-in, model of Manbattan

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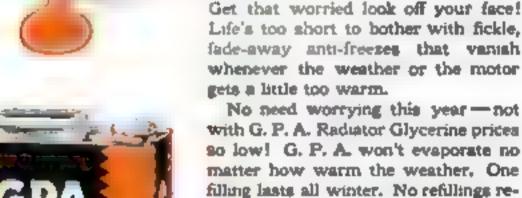
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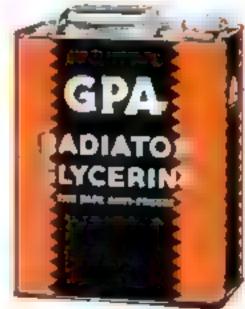


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HOW TO GUM TEETH OF CORDWOOD SAW

GUMMING a cordwood saw can be done by farmers who have a power grinder The work consists in grinding out the throat of each tooth to make large, round gullets of a uniform depth. These prevent the saw from binding and cracking

Saw-guining wheels that are 1/4, In and 3/2 in, thick and 6 or 8 in, in diameter are used for this work. The thickness of gummer required is determined by the saw at hand. The 14 by 6 in size is suitable for most farm saws

A stand or support needs to be placed under the saw at the same height as the top of the tool rest of the grinder so that the saw may be pressed straight against the gummer and so that the edge of the guilet will be square to the side of the A slanting edge would cause sawdust to be wedged against the side of the

saw kerf and the saw

wasid bind

The shape of the teeth of a cordwood naw is shown at A. The fronts of the teeth patch to the center of the saw. The saw is placed on the st nd and tool rest in such a position that the gumming wheel aims tangent to a circle which is about one third from the rim to the center. A carele may be drawn with a piece of chalk as shown in the photograph above, and lines ruled from the points of the Leeth Lan-

The teeth shown at B, improperly shaped and filed, are typical of those found on farms. Keep in m nd the shape

gent to the circle to serve as guides

of the teeth, as shown by the dotted bee C. An outline of the teeth made with chalk on the naw is helpful.

The gumming process may be started at D so as to produce the correct shape for the back of tooth E. In many instances the front of the tooth needs to have considerable metal removed to give it the correct shape. Much of this may be removed with the gummer as at F To give the right "hack" to the front of a tooth, the gummer is asmed toward the center of the saw. To prevent overheating the steel, bold the saw lightly against be gummer and move from one guliat to another frequently. The surface of the

> gumming wheel needs to be cleaned off and kept to the destred shape with an emery dresser, If much gumming is done on one gullet at one time, the saw blade may become beated sufficiently to caseborden the steel

In figng the teeth, only enough metal is filed from the front of a tooth to give it the correct shape and to bring it to a point. Filing is then done on the back of the tooth to give it the shape shown in the drawing at G .- L. M. ROEHL.



Dangtons showing how the newgumming wheel is used to grand the treth to the correct shape

WATERPROOFING PAPER ONE of the most effective methods of

waterproofing paper known, and one for which the ingredients may be purchased at the corner drug store, is as follows A solution of enoutchour is prepared. This is India rubber dissolved in caoutchin (oil of exoutchour), which is an oily, volatile liquid easily obtainable. The unsured paper, free from grease and dirt, is placed in this solution for a few seconds. It is then hung up to dry.-L. A. L.

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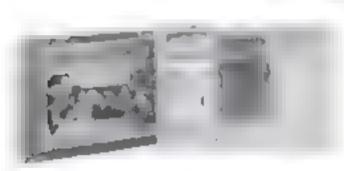


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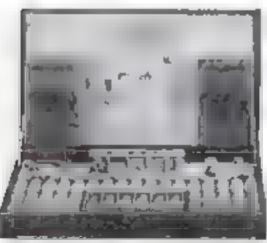
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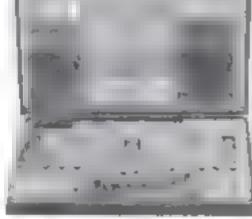


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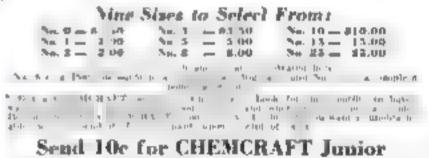
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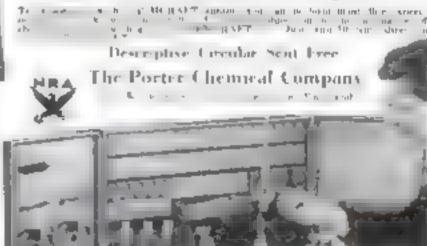




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CARDBOARD TUBE USED FOR SAWDUST CHUTE

F YOUR circular saw does not have a sawdust collector of some kind, a chute made from a strong cardboard tube not se s than 3 m, in diameter may be used to direct the sauthast into a box. In the installation diestrated, this is the same box in which the planer shavings are collected.

The tube should be about 1/4 in. thick, The bend is made by matering the tube and Joizung



Sawdost in discharged through the tube into the same bee used to catch planer chavings

with rummed paper or surestal tape. It sexeral layers are applied alternately across and around the joint, a surpresently strong joint will be obtained. The upper end of the tube is cut to fit around the sawdust nozzle on the much ne. As the saw illustrated has a beau around the discharge opening, the tube was fastened to it by wrapping a piece of baling wire around the tube above the bead and twisting it tightly with the pliers. In other installations it may be more convenient to use B C-clamp.-Dovard A. Parcu.

QUICK-ACTING HOLDER FOR RUBBER BANDS

RUBBER bands snapped around small packages with the aid of the hokler illustrated, [L is simply a pecce of wire bent into the shape shown and with the epds inarted in holes dolled in a sustable wooden base. dimensions depend upon the bands used and the size of the packages, but J in. across the top is suf-



ficient for ordinary purposes. This particular holder has a capacity of 100 bands. The parkage is placed on the top bar, and the rubber band is drawn up over it. The band automatically stretches to the proper width and snaps around the package without further

hand me - Dyncer Revnous,

HEISA "keen fellow-"



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NICHOLSON FILES A THE TEN THREE TREATMENT

MAKING SET OF WEIGHTS FOR A BALANCE

A SET of weights sufficiently accurate for a balance used for home chemical experiments and photographic purposes can be made with little difficulty. The balance I use was made from instructions published in a previous kaue (PSM., May '32, p 106). For the metric system at least four weights are required for a balance of this type—two 10-gram, a 20-gram, and a 50-gram. A 100-gram weight is also useful

Obtain a 10-gram weight or two United States 3-cent pieces, as a nickel weighs 5



By method cally balancing weights against each other, 4 complete net may be prepared

grams when m nied. Place them in the left-hand pan of the batance and move the slider to the extreme right and of the slider arm. Be sure to leave the slider in this position while making the weights. Balance the scales by filing the saider, if too heavy, or by adding solder to it. if too light Remove the weight solder to it. if too light Remove the weight from the pain and set it made, as it will not be beeded again. Place a piece of brain or lead in the left-hand pan and trim it to balance the scales, making a 10-gram weight As two of these weights are greated, but ance the scales again with another piece of brass or lead.

If lead is used, it may be melted and tast in a 1/3 by 5 in, test tube if a little lard or oil is acked to prevent the lead from adhering to the walls when cold. The grease will not mix with the lead and can easily be accubbed from the casting when it is removed from the tabe.

Take one of these 10-gram weights, place it is the right-hand pag, and balance as before, making a 20-gram weight. Place the two 10-gram and the one 20-gram weights in the right-hand pan and balance the scales, making a 50-gram weight. A 100-gram weight can be made by adding the 30-gram weight to the rest of the weights in the right-hand pan and balancing as before

It is essential that the slider be left on the right end of the slider arm while making the weights and that the weights be trimmed to balance the scales exactly. In weighting, always put the substance to be weighted in the right hand pan and the weights in the right hand pan. Saitti Hanais, Ja

To RECEIVE ATTENTION, every inquery relating to articles published in Popular Science Monthly must be accompanied by a self-addressed, stamped envelope. It is important that the questions be brief and to the point. Mention the article, the page, and the issue of the magazine to which reference is being made.

Scientists Create Sensational Monster



Giant Pre-Historic Ape that Growls and Moves with Spine-Tingling Reality Scores Hit at Chicago Fair

Creators of This Mammoth Say Plastic Wood Played Important Role in its Making

In a great New York studio a group of artists created the pre-historic mammoths that make "The World a Million Years Ago" one of the most popular exhibits at the Chicago Fair It rook a lot of ingenuity and plenty of Plastic Wood to make these realistic monsters. Craftsmen have found Plastic Wood indispensable in achieving perfection in their work.

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Constructing this

Upholstered Stool

mose or low may be subset used



HE uphoblered stool shown below may serve as a foot rest for a person reclining in an easy chair or it may be used by a ch ki to sit on

Start with the legs. As each of these have two square parts to which the rails and stretchers are joined, it is necessary to square the legs to thenessons before beginning the turning. It is preferable to plane one piere long enough for the four legs rather than cut four short pieces The legs should be about 12 to longer than needed so that the marks left by the lathe centers can be cut off Place them side by side on the workbeach and square lines on at four where the square parts are to he. Center each piece carefully in the lathe and make a little saw cuson the corners where the lines have been drawn. This will make the turning easier in that it will prevent chipping the square corners. Instead of being turned, the lees may be shaped on the edges as shown in the alternate detail

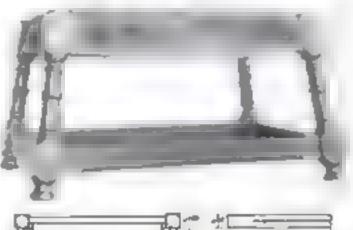
After the less have been turned. it is peresonty to make a full-stre layout of the side and the end in order to obtain the correct angle of the cuts and the exact length of the pieces. The tails and stretchers are then cut and planed to size. The side rails should be left with straight edges until the mortise and tenon joints have been made. Similarly, no chamfers or beads should be cut on the stretchers until after the mortesing has been completed.

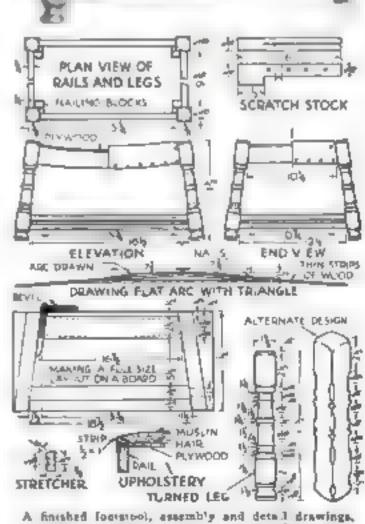
The mortise and tenon joints are laid out in the regular way except that the shoulder cuts on the tenon: are marked with a shding T-bevel set to the correct angle as shown on the layout drawing. The teroors on the tails should be 34 in. thick and the tenous on the stretchers \$716 in thick. The rails and stretchers should be set in 14 in, from the face of the less. Fit each murtise and teaon joint and number the parts. Then fit each side and each end

together and see that they correspond in size.

The chamfers and heads are now cut on the stretchers. The chamiers are taid out with a pencil and worked out with chisel and block plane. The beads are cut with a homemarle tool ca tea a scratch stock. It consists of a piece of hardwood of the approximate ditornwood shown on the

deawing. A cutter, fied to shape from an old saw blade, is inserted in the saw cut and beld in place with screws. This tool is also





an externative leg, and a accetch atock for beading

useful in making small moldings from closegrained hardwood when suitable stock moldines are not avaluable for any project.

The area on the side mile have such a long radius that they are difficult to by out An easter way is to drive three nails into a hourd as shown. Make a triangle of three pieces of thin wood nailed together so that its apex is at the center nail and its sides touching the other two nails. Hild a pencil at the apex and move the triangle from side to side, and an are of the correct curvature will be drawn

Sand the legs in the lathe and cut them to correct length. Then glue the two encls. Each end is clamped with two ber clamps. Wedge-shaped blocks are placed between the clamps and the legs to protect the surface of the wood When the ends are dry, they are glued together with the other two mile and stretchers.

Before the uphobtering is done, the stoot should be sanded and given a cost of stam.

List of Materials Number Percer Description * All 3 7 End m a Spleametchett End strep hers Sent box one phywood at 1. Strops on origin Note I three room are given to subset These are fig shed are

It is then prepared for the uphestery by fit ting a piece of the or I to in piewood ground the legs and has by it to the upper edge of the rails. The plywood is made flush with the outside face of the rath. A strip of wood 1/2 by I in is then planed to shape as shown on the uphobtery drawing and nated or screwed over the plywood to the rult. Let it project 1/2 in over the sides This forms the edge of the seat and gives it the proper shape

It is best to use hair for the stuffing, but most or tow may be substituted. Pick at the lumps out of the half and spread it in an even layer over the sent It may be brid in place either by driving some tacks through it into the plywood or by brushing some give on the plywood before spreading the hair, Another layer of bair is then placed evenly on top of the first and a piece of musan stretched over it and tacked to the lower edge of the tails. It is also tacked in the curpers around the legs to blocks previously nailed to the legs

The stool may now be given three costs of a good subbing varnish. Varnishing should always be done in a dust-free, warm room Rub the first and second coats with No 2/0 or 3/0 steel wool and wipe off with a rag moistened in turpentine. Rub the last cost with a felt pad, powdered passive stood. and crude oil. The turned part may be rubbed with a piece of waste or with a brush baving close, stiff bristles

The covering is now nailed over the mus lin. A piece of cutton wadding should first be placed over the muslin to make a more even surface. The edges may be trimmed with a narrow gimp or band of the same or amiler material as the covering. Fancy brass nails or gimp tacks are used to festen this trimming.

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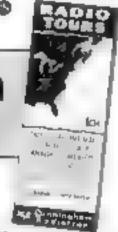
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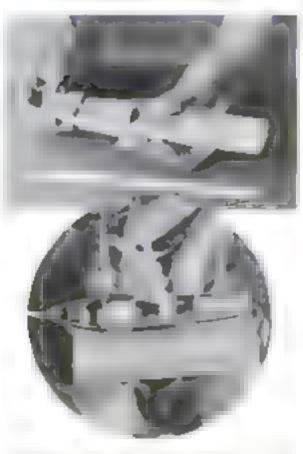
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CLIPPER SHIP MODEL

(Continued from page 6,)



Holding a bulwark in place until the glue pets, and erecting the assembled mainment

with the samplification of the presious models of boats and planes described in this series.

The anchor will look realistic if it is made of time were such as is used for making arinficial flowers, twisted and glued as shown in one of the sketches. Several wrappings will be needed to get the right thickness & bit of match stick will serve for the stock or crossbar Paint the anchor black Two can be made if desired. The anchor chain and the bobstays can be represented with small chain of the lund used for restringing beads. This can be obtained in the ten-cent

Havang completed the work thus far, you are ready to point your model, which should be done before the negine goes on. Var nuh the decks and the upper masts. Give the remainder of /t would - pure to

List of Materials

	PE	
10 16 x 15, x 01/2 14 x 36 x 21/3	1	Whate pine for a White pine for C and K
3, 16 x 9/16 x 335		White pine for limits, f and V
4 X 74 X B		White pine for keel, stem rud- der T. E. F. H. I. L. and M.
4 5 3 4		Lor person as a reconstruction of a formation yards and bownprit
11x21z		Cardboard for bulwarks stem piece mast cape ladders, chan nels, wheel and details
3 i 2 3 3		Fiber for cross- frees, tops, and howspar, cap

3 roje thin back cord for chrouds back stans the black thread No. 70 an thread No. 3 small chain (type used for restringog beads) fine wire, large size match sticks safety match eticks, casein glue and household rement this paper for flags, varnish, and paint or enamed in black, white, red, copper, and mahogany color, small beads.

AN AMATEUR

did the inlaying on this table top

IN 4 HOURS



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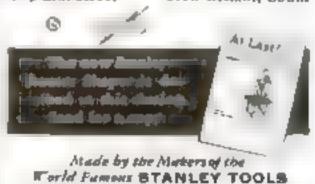
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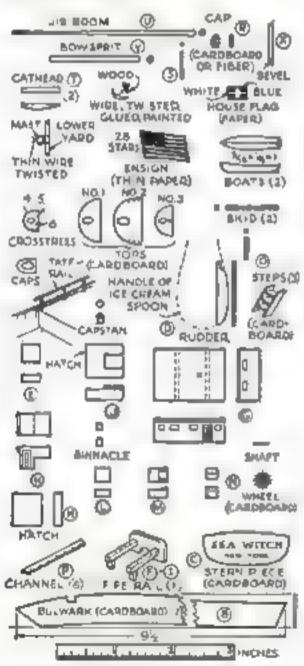
CLIPPER SHIP MODEL

(Continued from page 82)

the ship a cost of flat white. Paint the bottom of the bull up to the water has copper colored. Paint the upper part of the hull black, and when dry add a red and white ribbon strips at the deck level, Make the bowspitt black, also the yards, windows, doorways, and tips of masts, gaff, and boom-Paint the catheads and hatches E, H and J black, but use white on the deck houses, skylight L, parts M, N, the binnack, and the capsian. The lowermasts and doubtings should be white. Use mahogany on the gall and boom and for trimming the deck houses. Paint the name on both sides of the how and on the stern with white. Four-hour enamel is well suited for this work

To rig this little ship you will need at least 11 yards of thin black cord for the shrouds, backstays, and the file; also several yards of black thread and tan thread No. 70. The tan is for the running genr Small beads will do to represent deadeyes and can be glued in place on the thread. Lines can be secured to their points by tying or, in some cases, by gluing

One of the photos on page 52 shows how to mount the boat while the assembling and rigging are being done. The holes for the dowels should be drilled into the hull at one aids of the keel.

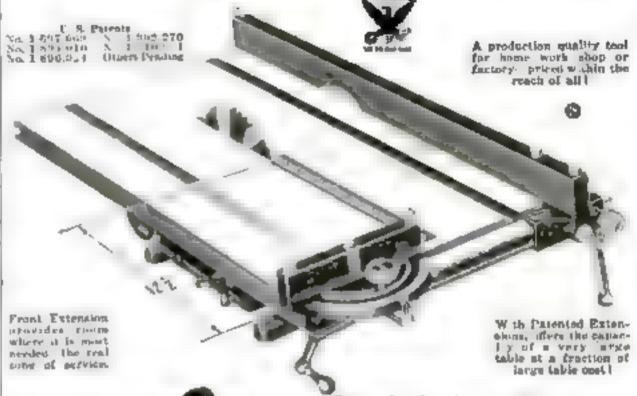


Details of all the small parts with an inch acale. The taffrail is not an espectial fitting

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AFTER a soulering copper has been used for some time, the point becomes pitted and cannot be tipped evenly. This can be remedied by heating the copper to a cherry red and hammering the point out to the desired shape, reheating as necessary.—Basyle Palmen.

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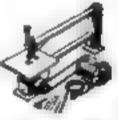
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THE GRIEF OUT OF

A sudden leak in the heating boiler-the hammer handle flies of -water against from a deal in the auto radiator—a drawer knob pulls out — screws strip

from and loosen the door lock-a water pipe freezes and cracks - one caster won't slay in the tabie leg-your lavorite pall starts to leak - a preso tentividase nut puts the vocuum. cleaner out of bunneus-rie -rie



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COMIC-STRIP "TALKIES"

Continued from page 61)

with scouring soop, and secure in place so that they will come directly behind the bulbs. Screw the lamp receptacles Just for enough from the tin to permit inserting the bulbs Without letting them touch at the sides. Wire

the receptacles in paralle-

To make the mount for the less, cut a piece of the fiber board 2 by 3 /4 times the diameter of the lens, Round it into a tube (marked IT in the drawmen) in which the lens fits anugry, and give the seam. Make two diaphragms Of for the lens of the same material as the tubes, cutting them as shown. The diameter of the circle encompassed by the dotted line is exactly the diameter of the lens and that represented by the solid line, // in. less, The tales are 1/2 in. long. Insert Tube IT in the hole in the front of the lantern to hold it steady as you place the less and disphragms as shown in the cross-section drawing and one of the photographs,

The outer tube (marked OF) is also cut from the fiver, measured off 1/4 in, longer than the flat dimension of IT, and 1 in narrower Cut be-in tubs along the enters length of one side, Bend it firmly around IT and glue the seum. When dry, insert it in the hole in the inntern, tabs toward the inside Bend the tabs and tack them to the wood. Tube IT should

be a de to dide easily within OT

The last step is to make the "reel." Cut the comics into strips, leaving a 1/2-in, margin at the left hand end of each. The margin on each new strip will go under the close-cut end of the preceding, A leader-a paper strip | () long-is pasted on the left of the completed reel; when the reel is rolled up, this leader will be on the outside. It is fed through slot S and out through St, with the pictures upside town, To keep the pirtures flush with the oack of the lantern and in focus, it is most convenient to cut two pieces of the fiber 7 bs 3. n. These are carred a bit and thumbtacked in place over the strip.

For a test showing, puspend a sheet in front of the ran o, place the inntern about B ft. away, darken the room, and light the bulbs. Slide the lens back and forth until the made is clear and sharp. I speciment with

the lantern at different distances

For the reading of the parts, it is most convenient to buy a second copy of the paper. Although the entire picture is abown on the screen, the audience will not read the

lettering, which is all reversed.

Hook up the microphone according to the instructions coming with it, carry it to the actors, who should be stationed beyond suffitient sound insulation so that there will be no tendency for the radio set to start "bowling," and make a final test. Speak clearly, not loudly, with the mouth about 6 in. from the instrument

List of Materials

A not 4 sq. R of any lumber cut into ten pieces as fellows

D, D1 13 in by 1'11

3, At 7 in. by 13 in. less twice the finchness or the wood most

H. AL

1 in. by 1.37 11/2 in, by 1.1/2 less twice the thickness of the wood used E. El

a first paths.

? flat-case lamp receptacies

I magnifying glass at least 2 in. In diam-

Some flexible cardboard or bookbinder's fiber bunrd

Lamp cord and connecting plug

2 lamps, 100-watt

Sheet to serve us a screen

I home-broadenstang microphotes (cost og n Phis case 55 cents)

Radio secriving set

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HACK-SAW BLADES KEPT TOGETHER WITH RINGS



Loose-leaf outsbook rings are used to bold together a supply of extra heck-new blades

THE usual small amortment of reserve back-saw blades kept about the bench or carried in the tool hit can be held to gether as abown above by snapping a small loose-leaf notebook ring through the holes in each end of the bunch.-F W.B

HOW TO MAKE SANDPAPER STICKS AND SLEEVES



Left to right, a acraper, sleaves drying on forms, two of the forms, and finished sloeves

SEFUL round sandpaper sticks for smoothing small, sharp curves can be made by coating various siers of wooden flowels 3 or 4 in, long with surplus glue that will not keep oversight and then wrapsing strips of sandpaper around them in spiral fushion. The sandpaper should be cut about I in, wide. Cord is wound around each spirally until the glue is dry. As these sticks may be held in the drill chuck of other a drill press or a lathe, they save much tedious work

Those who have the newer sanding drums that work on the expansion principle and use sleeves of sandpaper may also make up their own sanding sleeves. Forms should be prepared about 1/16 in larger than the diameter of the drum. These may be turned from any waste wood and left along enough for two or three sleeves. A piece of this form is then cut off lengthwise with the carrolar saw, so that it can be removed easily when the sleeve is dry. The paper should be cut on an angle of about 30 deg, for the larger sized drums and about 34 in longer than the circumference of the form. This 14 in. in scraped clean of sand before the glue is applied. The paper is then glaed, wrapped around the form, and bound.- H. Calawritt.

QUICK WAY TO TRANSFER SMALL WOOD PATTERNS

Wirest several duplicate wooden parts of irregular shape have to be as sawed or cut out hy hand it is not necessary to trace the pattern on each piece of stock. Simply cut out one piece and lay it on a sheet of carbon paper. placed face down on the wood where it is desired to repeat the outline. Now hammer cently around the edges of your pattern, gung a block, if necessary, to protect the stock. If the design is small, one rap on a block on top of the pattern is enough. Very fine tracery can be accurately reproduced in this way. After the duplicates have been cut out, the surplus carbon should be sanded off if the work is to be lacquered, as some carbon has a tendency to work up through the finish.—R C CROUSE.



JUNIOR HOME WORKSHOP SPECIAL

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RETAL CAST PRODUCTS CO. 1898 Bester Reed, Mew York



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Model Ship Supply Co., Dept. T. Minesia, N. Y.

POPLLAR SCIENCE MONTHLY

HINTS ON REPAIRING JIG-SAW PUZZLES

FINELY made wooden fix-sow puzzles a ten became broken and societ from careless handling and much use. The chief damage is that caused by lost pieces. These may easily be replaced by new ones.

The puzzle must be assembled in order that the pattern may be obtained Instead of making a rubbing, as is commonly done, turn the puzzle with the picture side down and cover the surface of the wood of all pieces that surround the hole with subber cement allowing it to dry. On a scrap of plywood. glue a piece of clean, white bond paper When this is dry, coat the surface of the paper with rubber cement and let it day

Press this piece firmly over the hole in the puzzle, with the rubber-coated paper surface down. The comented parts of the puzzle will adhere firmly to the paper Lift the section as a unit from the hody of the puzzle.

Saw in through one of the original cuts and continue pround inside, close to the edges of the pottern pieces. Cutting slightly into the original pieces will do no harm.

Remove all the plexes from the scrap wood by lifting them gently with a knife blade. Replace them in the assembled puzzle and remove the dried rubber cement with an croser or a small buil of the same material Turn the puzzle over again and paint the new piece to match using water-color or Oil guan s.

Sma. keys or tips may have become broken off leaving small holes in the puzzle. If the broken piece is found, it may be glued into the whole piece into which it fits. It this small fragment has been lost, the bole can be plugged with a plastic wood compact tion or gross mixed with enough fine sawdust to make it stiff. Press this plastic material firmly into all holes and let it dry at least eight hours. When solidly get, remove the groups of pieces which have been stuck together. Run the saw carefully through all cuts, sawing off the paug of cement at the point where it was broken, as this is usually a thin neck and likely to break again. Replace the repaired part in the assembled paszle, turn it over, and paint

Where the picture has become loosened from the wood, it may be glued back into place with a toothpick dipped in glue If spots of paper are torn off, glue bond paper to the spot and trum the edges with a sharp

pointed knife, and point Should a large piece become broken, soak off the sections of picture and glue them to a scrap of plywood in the proper position. When dry, saw close to the edge

If the back of the puzzle in badly soiled, cleat the whole thing securely, face down and plane with a small block plane, the blade of which must be very sharp and set for a shallow cut. If preferred, the surface may be sanded, but this is slow and laborious.-W L Patror.

MANY THIN MODEL PARTS MADE AT ONCE

To make a large number of small brass or copper plates for a model, such as are tequired, for example, in making checks and bollards, time can saved by lightly sudder- pLAYES SOLDERED, ing together the desized quantity of small pieces like lam nated thems. The pieces are then shaped and drilled as a unit. When they are separated, they are certain to be of uniform size.—R. J. H.



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The C55 Clutch, shown above, as a setf contained unit, factory tested up to 5 HLP and ready for immediate attachment, Fits a 34 Shaft and has cone pulley diam. 31/2 Sample lever control. Price \$5,50. No. C40, not shown, is for lighter machines. Has 4" outside pulley diam, and 1/2" bore. The complete price is only \$3.85.

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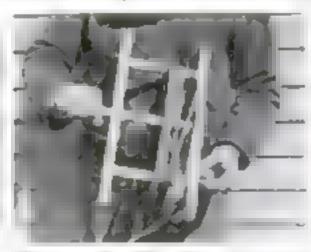




QUICK-ACTING WINDER FOR CLOTHESLINES

NE broom handle and a few pieces of pene will make this handy device for winding up a clothesline or wet fishtine

Cut two sidepieces 14 by 1½ by 16 in. and bore a 1-zh, bole through the center of each Three unches in from each end bore a 66 in hole. A 75 cm. piece of broomstick 13 in. long is inserted through the center holes, extend-

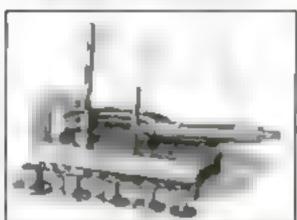


This homemade winder cavolves on the central handle, which saves considerable time

ing out 5 in to form a handle. If two nails are driven into the handle within the frame, and their heads so pped off and best over, the bandle will revolve freely yet will not sup at of he hotes.

Two 8-18, pieces of broom handle are nasled firmly in place in the upper and lower holes to form the ruck. A 155-in. knob. attached to the side of the frame by a 75-instove bolt, allows the operator to turn with one hand while the other hand grasps the handle Racen Sero Schlass

LAYING OUT DRILLED HOLES ACCURATELY



Bushings for sying out terrain varieties of machine work with a high degree of accuracy

OLES can be dolled and reamed quickly in just or dies with the aid of a set of bardened and ground bushings but ordinary work six bushings are sufficient with holes varying from 56 to 46 in, in diameter It is important that the nutside diameter of the bushings be concentric with the hole and there should be a wall of metal at least 34 in thick, that is, for a 34 in hole the out side diameter should be at least 1, in

The first hole is dialied and reamed and a pin is inserted. Then one of the bushings is set at the proper distance from the first hole by measuring the over all distance with a micrometer as shown. If the center distance between the holes is " in., for example, and the pan is 1/4 is. in diameter and the bushing I in, in nutside diameter, the micrometer measurement will be 4 plus 34 plus 1, in , or 44% in. The bushing is champed in position when properly located, and the hole is drilled and reamed. These bushings will enable work to be laid out more quickly and accurately than by any but the button method - Chauses Morean



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HOMEWORKSHOP GUILD

(Continued from page 63)

supply suggestions and plant for meetings and a model constitution and by laws. Detailed instructions as to how to organize a local club, conduct the first meeting, elect officers, appoint committees, and all that you need to know about the movement are available.

Until larger quarters are required, meetings can be held without expense in a school-room club, church hall, factory, or private resinence. The Rockford Cash started in the employees' meeting room of an industrial plant.

A SPEAKERS' bureau at the national headquarters is to arrange for lectures and demonstrations before the lucal class when a summer number of them are organized. A monthly news letter will suggest plans for meetings and programs. Professional craftsmen will aid members in the solution of specific problems. Methods of increasing interest and membership are to be relayed from one local group to another Local exhibitions will be held by clubs and, when practical a bandwraft contest or national exhibitions, probably on an annual basis will be held under the auspices of the Guild.

The Garki is to be entirely noncommercial. The smaller which the parent organization will offer from the local clubs will be used entirely or promotional activities for the

benefit of the whole Guild.

In order to obtain the widest publicity and gain the utmost support for the new movement, the Guild has chosen Porugan Science Monthly as its official organ and but made Arthur Wakeling, the He me Workshop Euror, a member of its board of directors. The activities of the Guitel and of the local clubs will be reported from month to munth in this magazine. It should be minute clear however that the Union idea originated in Rock and and that the headquarters are established there. This magagone has no wher connection with the Na ticnal Homew rishen bound swhich should not be confused in any way with the Popular Science II meemit Guin for listrouting construction kits) than us a medium through which to give it adequate publicity and reli-Lordal nupris rt.

In every community there are men who are finding to aration and pleasare in their workshops. They usually work alone and are abacquainted with others who have stmilar tastes in their own neighborhood. They are frequently poor mixers but there is no reason why they should work longer by themselves. A local home workshop dub will bring them together and be of immerise value. If you wish to take advantage of this opporture a not be part a club organized in your locality fill out the couton below and send a large self-addressed, slamped envelope.

National Homeworkshop Guild c/o Popular Science Monthly 381 Fourth Avenue, New York, N. Y.

Please tell me how to go about forming a local home workshop club and what the National Homeworkshop Guild will do to help. I am inclusing a self-addressed, stamped covelope

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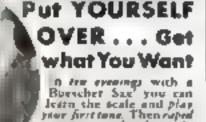
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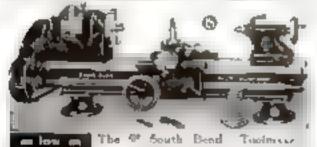




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Jig-Sawed Metal Silhouettes Serve as

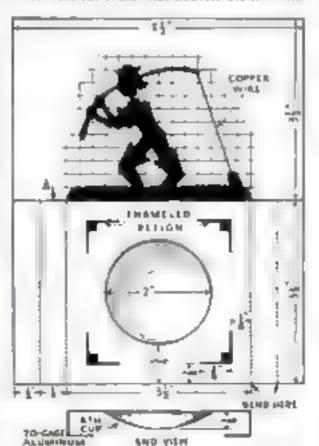
ASH-TRAY ORNAMENTS

By Robert J. Williams

LTHOUGH jig naws are ordinarily as sociated with wood rutting, light gage about metal is very easily maked on them and with even better results as there in less likelshood that the small projecting parts will break off. A Jig saw was used to cutting out the silhnucite figures on the metal ash trays illustrated above. Any of the softer metals such as copper, aluminum, or rinc, about 18- or 20-gage, in salisfactors

Since fishing is a universal sport, details will be given for constructing the comic fisherman ash tray first. It is made from a single sheet of 20-gage aluminum. The ash cup circle and the dotted bendung lines are marked off on the metal, then an outline of all the parts of the fisherman above the base one A, as indicated in the diagram, is drawn on a sheet of paper. This sheet of paper becomes the cutting pattern when it is attached to the aluminum. Auto-gasket cement makes an excellent adhesive for this purpose

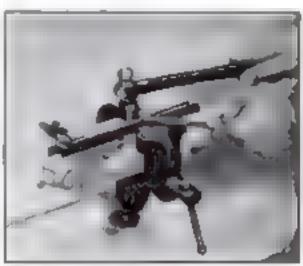
The aluminum is now ready for the jig raw. Instead of the fine picture-puzzle saw blades, use the comewhat heavier blade manu-



How to make the fisherman's tray. The donign in drawn on 4-10. Squares for entarging



A amouth concave selt cup to farmed by hammeeting the metal down over a hole in a board

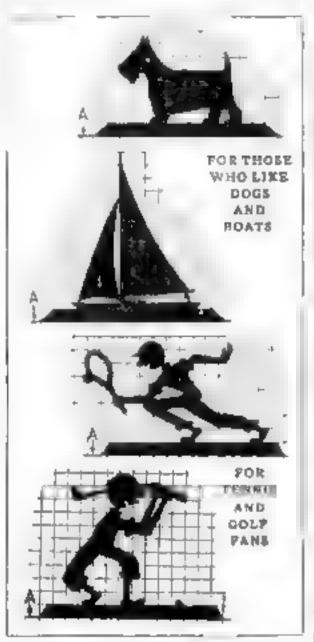


When making the straight bands, houp a strip of wood between the metal and the hammer

factured especially for metal cutting. Drive it at the slowest speed and cut cear of the author so that the rough screen may be smoothed down to the lines with a file. Of course it is necessary to drive hole for inserting the blade in the inclosed parts that are to be cut out

The next operation is to form the ash cup. and this is not as difficult as it may appear A hole 2 in. In drameter is Jig-sawed in a hardwood board. The sheet of aluminum is mared with its scribed circle exactly over the hole to the board Starting at he center of the circle and working out toward the edge, hammer the metal down into the bote By tapping bightly the ash cup can be formed into a smooth and un formly concave shape. Further amouthing of the cup is done with fine sandpaper, and at the same time the remainder of the paper pattern is sanded off. A final polish should then be carefully given with steel wool.

Square bends are easily made by clamping the aluminum between two iron bars along the dotted line. A more of soft wood kept between the aluminum and the hammer will prevent any sharp deats. Bend the two leg angles first, then make a right angle bend along the base line A so the subouette stands upright. The fishing line consists of a piece of copper wire with one end fastened



Four other designs drawn on to in aguates. Bolow A they are I ke the flaberman's tray

through a small hole in the head of the fish and the other wrapped around the pole

All parts above the base are enameled back or any desired color. To enhance the appearance of the tray simple designs are last out with a pointed instrument in each corper of the top and filled in with enamel. These designs may be left off, though putting them on gives a more finished appearance to the tray. To keep the unenameled part bright, give it a coating of thin, clear

Any of the other silhouette figures may be substituted for the fisherman by using the proper cutting pattern above the base line A as all dimensions are the same below that line. To enlarge the figures, draw a series of 1/4-in squares and copy carefuly from point

to point

TYPEWRITING LABELS ON ADHESIVE TAPE

Exceptions labels can be made from adhesive tape, but they are much neater if the lettering is typewritten. Of course, you can't put the tape in the typewriter with-out gumming up the toiler. The solution is to stick the tape on a piece of wax paper or cellophane of a larger size and insert both in the machine. The tape is easily removed after typing, and the adheave quality is not impaired,-W E. Le Count.

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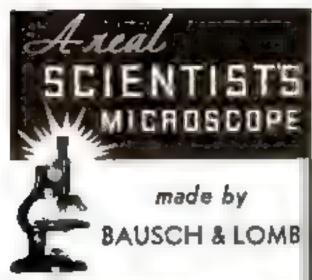
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MICROSCOPIC MARVELS IN YOUR WORKSHOP

(Continued from page 45)

etching solution is prepared by maring one part of nitric acid (concentrated) with more parts of alcohol. Etching is complete in ten to filteen seconds.

Ordinary uncture of judine can be used Spread a drop of it on the polished surface and let it remain until the metal is discul-

PERHAPS the quickest and simplest way is to dip the polished surface of the metal specimen into concentrated natric acid and ammediately plunge it into water. The good can be dropped on the metal with a medicine dropper, instead of dipoing. In this prohas been diluted with water, and it continues only for an instant because of the rapid enuffun.

Your specimen of cast from can be examined under a low magnification. If the polishing and etching have been done properly, the structure of the metal will be seen plainly, its exact patters depending on whether the cast from is white, gray or motted. Some specimens will show light, pregular paidles of ferrite surrounded by free carbon or graphite. Cast fron contains carbon schoon phosphorous support, and mangahese in addition to trop It differs from seed in having more carbon, part or all of which may be in an uncombined state. The carbon percentage may be between two and five-tenths and four per cent.

Well-equipped metallungsità use vertical illumination for examining and photograph ing metal specimens, the light being directed downward through the microscope objective and then reflected back up through the same lenses. However, you can obtain satisfactors results by directing one or more brams of ight downward on the metal, making them as nearly vertical as possible.

Move your microscope from the scrapmetal pile to the lumber rack, and you will find material for bours of fascinating entertainment. By looking at bits of wood, you will learn why some lunds are stronger than others, why some are flexible, and how the arrangement of cells determines grain but term

In wood, the cell is the building block Cell structure determines whether the wood is still or flexible, heavy or light, soft or hard. Cell arrangement also determines the appearance which, in many cases, is the property of greatest value. Woods can be elentrified definitely by microscopic examination of cells and their arrangement

I F YOU examine the end of a piece of oak under the lowest power of your microscope, you will find it is made up of circular cells, somewhat resembling a honeycomb from which the surface has been scraped The cells are arranged in curved layers. If you could see the whole tree, you would find that these layers form rines, each representing a year's growth. Towards one other of each layer are a number of very large cells. This part of the wood grew in the spring. The remainder, in which these rells are smaller, is summer and fall wood

a piece of lumber made up mostly of spring-grown wood is not as strong as that which arew in the summer and fall. Here and these through the specimen, you will note streaks of cells that run roughly at right angles to the seasonal rines. These are the medullary rays which in the living tree serve to carry water between the inner and outer parts of the trunk and to store excess food.

Trees with broad leaves, such as the oak and maple, have three kinds of cells. The majority are wood fibers, which are long. (Continued on page 93) narrow cells



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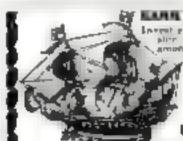
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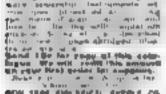
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(Continued from page 92)

varying in size. If you look at a thin slice of wood cut parallel to the grain, you will see that the fibers are tapered at the ends and fit together like dovetail joints.

A second type of cell is the trachesd. It is wider and shorter than the fiber and its ends are not as sharp. The opening through it is wider and there are thin places in its walls, called pits. These pits, in life, are aseful in water carculation. Sometimes the wood can be identified by the shape and arrangement of these pus-

The third type of cell is the veisel or duct, which resembles a sectional sewer pape, and is made from rows of trached cells. These vessels may be a yard long and one onehandredth inch wide in some trees. Wallsare putter

While studying the wood fibers, you might compare them with steel. They are remark ably strong, sometimes possessing, according to some botanuta, one fourth the length strength of steel, and one half that of wrought from You can find much enterlainment in examining the structure of wood that has broken under a load or stress, and noting the odd shapes the fibers assume

Consigrous woods, such as pine, do not have vessels or fibers. They are made up almost entirely of tracheids with pits that can be seen in the walls. The tracher's in pine are about one-sexteenth inch long. They serve both to produce strength and carry water. In examining a cross section of pine, you will notice that there is an abrupt change from spring wood, with its large cells, to aniuma wood with small cells. Here and there you will find large openings surrounded by cells that are somewhat evalshaped. These are resus ducts, fined with epithelial cells. Medullary rays can be seen running at right angles to the spring lines.

The preparation of wood specimens is not difficult. With a sharp plane set to cut very thin shavings you can obtain all the longtadinal sections you want. With a sharp rator, you can above od very thin aliteeither with or across the grain. Wood is easier to cut if it is souked for several days in water, and you can produce thinner and more uniform sices if you use a hand mo crotome. (P S. M. June '33, p. J3)

If you have occasion to do a great deal of work with various woods, you will profit by building up a library of photomicrographs showing cell arrangements in various woods. These can be used for identifying doubtful samples

Speaking of photomicrographs, it might be well to describe a stunt that seems not to be generally known among microscopists including advanced workers. A camera that has no focusing back can be used to make photomicrographs with success. This opens the field virtually to everyone owning an in-expensive camera. The process is simple

First, focus the microscope sharply while your eye is focused at infantly. This is not at all difficult because your eye normally is that way when you are sludying a specimen Now set your camera at infinity. If there is no infinity mark on the scale ("Int." or oO), set it at 100 feet, because the average camera tens has its infinite focus at 100 feet and beyond. Place the causera, without removing its lens, in line with the microscope eyepiece, and provide some arrangement for keeping out stray light. The lens should be a fraction of up inch from the microscope evepiece, say about one fourth of an inch. Usually there is a repartion to magnification by this method in comparison to a set up empioring only the microscope lens. However, the reduction is not great enough to interfere with the usefulness of the method



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A GOOD TIP FOR ALL RETAIL MERCHANTS



THE name of thus man is unimportant. But the unsque method be is successfully using to collect old and bad debts may prove an eye-opener to many a business man. He lives in my town and he owns an independent grocery

store, with plenty of competition from chain and strictly cash stores.

I happened to drop into his store one day last winter while business conditions were at their worst in this little praine town of ours. After exchanging a few commonplaces, we brunched into a discussion of business problems in general and collection troubles, which are ever present, in particular

"The worst of it all," protested this man. It that the customer who has run up a large bill in this store invariably does the vanishing act. I don't mean skipping town. I mean moving their trade to another store. Soon as these had debtors do get a little tash, they go and spend it at the cham or strictly-cash stores. My hardest job is to get them to come in here and do a little cash business as well as creeks "

Just then an icy gust of wind swept the store as the door was thrown open and a red-faced, bulky man crossed the thresh-

"SEE here," he roared at the grocer, in all my life! It's an outrage, and I refuse to pay it "

Just a minute" replied the grocer, "and I'll check up on it " After studying his account book and checking the original toil be turned to the rustomer once more

"There has been some mistake. Your account is only half of this amount. I'm sorry; I apologize. I sent out those bills myself this month, so I must have made the mistake."

The anger on the customer's face slowly melted into an expression of genuine relief. And, of course, once learning that has bill was really only half of what the statement said, he didn't have the nerve to walk out without settling his account.

"Well, it worked," chuckled the grocer after the man had gone. "You see, I was just about to tell you of this new experiment when he blew in.

"Two months ago I looked over all my accounts and picked out every old, uncollected debt. Incidentally, this bill I just collected was in the hands of an agency a year (Continued on page 95)

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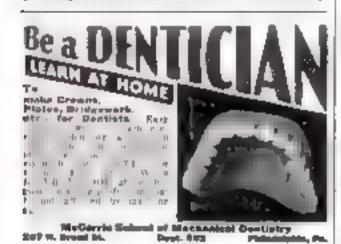
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A GOOD TIP FOR ALL RETAIL MERCHANTS

Continued from page 94)

ago and they couldn't realize a cent on at! Anyway, I selected several of the bad accounts, jacked up the bill ten or fifteen dorlars and sent out statements. When the customers received them they were furious. They immediately made it their business to come in here and let me have

a perce of their minds.

"But in each case their anger was appeased when they found I had made a mostake in the figures. And in each case, I received part or full payment on the bills before they left the store. You'd be surprised at the payments I've received in the last two months. Of course, I only use this method as a last resort, but it does work."-E,C.A., Hettinger, N. D.

MADE HIS OWN PLACE IN NEWSPAPER WORLD

FF THERE WAS one burning ambition in Paul Priggeos' life, it was to become a newspaper man. That was what he wanted -and that was what he was going to have. Having trained for this profession in college, after graduation he set about



looking for an opening in this field. But it wasn't as easy as that. Everywhere he was greeted with the same story-"Sorry

but there's nothing open now," Broke and discouraged, Paul finally returned to his father's farm near Belie Fourche, South Dakote, a small town of

2 300 population. Taking stock of the astuation, Paul came upon the same realization so many other men have in the last four years. To have a job, one

must create a job.

With that thought in mind Paul began to study the territory in which be lived. He soon discovered that a vast area was being inadequately covered by news in the daily papers reaching that section of the country. Why not cover it himself? Accordingly, he opened a tiny, second story office and went into business for himself

His first step was to write to the nearest Associated Press Office and offer his services for serving the territory which was at that time being inadequately covered. Results were immediately forthcoming. By return letter he was offered a job at regular "space rates." Then Paul went a step further. One by one he contacted the daily papers in that area and at the end of four months he had added ten dailies to his "string"

In the meantime he began a systematic building up of news sources in the territory. He called on weekly editors, county officials, agricul- (Contained on page 46)

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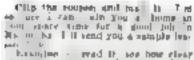
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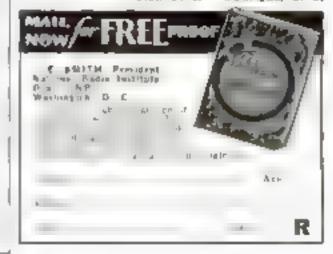
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MADE HIS OWN PLACE IN NEWSPAPER WORLD

(Continued from page 95)

tural and livestock associations, school and industrial heads, bankers and business men and explained that he had opened a news office for more intensified coverage of the area, and asked their cooperation. Weekly editors, he discovered, were glad to send him carbon copies of their stories which otherwise would have found no wider circulation, in return for a mimeographed weekly news pervice. covering the highlights of the week a activities over the entire area which Friggens compiled from the various stories.

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(Continued from page 63)

rare in the selection of colored bulbs. Rest ones make the material appear an unattractive brown. Better colors include blue, green, orange-amber, and yellow, all of which are standard hmp colors

The next time you purchase a Christmas tree, get one that is alive and has its roots housed in a tub. Then, after the holiday season, set it out in the yard. Every Christmas thereafter you can use that tree for supporting a string or two or colored lamps

NOVEL way of employing chisters or A strings of lamps for decorating the lawn a to use them in an ice mountain bimply pile teremmar churus of clear the over colored amps of 25 or 40 watt size. When the lamps are burn on at night, the tee pile will plow with countless colors, the more striking because of the prismutic action of the ice. If flasher buttom are placed in some of the sockets, the colured picture becomes a constantly changing one

When arranging the lee-pile lighting system, use weatherproof electric cord and sockets. Each bulb is fitted with a rubber gasket that keeps water from getting into the socket, and is provided with a wire guard like those used on trouble lamps, to prevent breakage. All of these items can be obtained at any large electrical store. You will find that an ice mountain will last for weeks if the weather is reasonably cold. Checken were can be used for holding the ice, if unusual shapes are desired

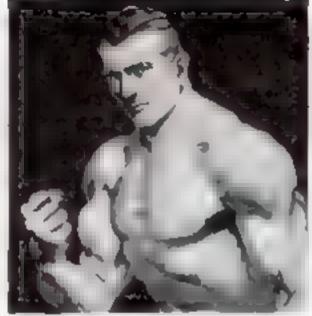
Christmas guests will feel more heartily welcomed if the walk leading to your house is outlined with candles. You can make the fixtures yourself from lengths of pape painted white, cresm, or any other culor and equipped with flame-shaped lamps at the tops. The pipe can be held in wood bases shaped like conventional candlests as

Many home owners have found that simple flood-behting by means of projectors giving while or colored light is an easy way of achieving Christmas lighting. A few projecfors are placed near the house and adjusted so that their rays bathe its walls. The projectors can be hidden behind shrulp or in hedges. You can purchase such equipment, or you can make suitable Bood-light units by fitting 10-in, plumminum mixing bowls with weatherproof sockets and using a rulber gasket to seal the bulb. Usually 100-wait lamps will be found aree enough. For special occasions, where the lights are to be burned for two hours or less at a time you can employ Africant photoflood builts which are e unvalent to 750 watt lamps. They are ideal if you want to make a picture of your lighted home

Another lawn or entranceway ornament that is attractive, although a little more formal than some of the others, is the lighted pyion Construct a fall column-shaped box a foot or two square in cross section, with the sides open. Cover these with muslin and place colored lamps within. Christmas designs can be paroted on the muslin.

"I'll silhouette in another form lends itself admirably to various Christmas highting effects. For example, a cut-out figure of Santa and his reindeer team, perched on the porch roof or other low roof and brought into prominence by a flood light behind, which throws its rays on the wall of the house, will give passers-by something to talk

A modification of the silhouette idea is incorporated in special lighted shapes, which produce spectacular effects. These consist of two or more cut-out figures of Christmas trees or other objects, painted fiat white and mounted a few (Continued on page 95)



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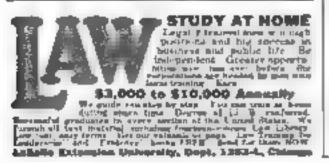
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HOTEL CLEVELAND





LIGHTING STUNTS FOR CHRISTMAS

(Continued from page 97,

inches apart. The smaller figures, of course, are in front, with those behind growing successively larger Colored bulbs are mounted so that they cast their light over the fronts of the cut-outs. If flashers are used in the sockets, and lamps of different colors employed, striking color combinations appear every few seconds.

Stors are standard Christmas decorations and are particularly effective when fastened at the peaks of roofs, on outside walls, in tree tops, and elsewhere. You can purchase read) made star ornaments which take 10walt lamps, but you will find it a simple matter to make your own. Construct a rectangular or circular box deep enough to hold a socket and lump. Over the front of the box pail a piece of plywood or composition wood that has a star cut in the center and is covered with translucent tracing cloth, shellacked muslin, or diffusing glass, Provide a beavy screw eye for hanging the box on a hook. Other stars consist merely of a plain wood or fiber piece with sockets mounted on the back, over holes through which bulb bases pass. The star can be painted silver or covered with linfoll. The box structure can be modified so that it is itself in the form of a star Stars should generally be more brilliant than surrounding lighting ornaments,

APPROPRIATE greetings such as "Merry Chesatmas" or "Yuletide Greetings" can be incorporated in electric signs placed across the front of your home or along the front purch roof. Perhaps the most satisfactory form of sign for home use consists of a long surrow but just deep enough to hold a group of lumps and sockets, and equipped with cutout letters in front. The letters are covered with shellarked mushs or diffusing glass.

The wreath in the type of lighted Christmas ornament most used indoors. Usually it is hang in a window or on a door. An attractive wreath can be made from a Christmas-Ires strong first make a ting o at if wire and tape the strong to it so that the eight larger and specied evenly. Excess electric cord can be doubted up and taped in place. Cover the ring with lawret, evergreen or holly arranging the lamps so that they project through, all on the same side Provide a colored cord for hanging the wreath to the window catch or a book.

As in outside lighting of your bome, you run use lamp strongs to decorate interiors You can suspend them over openings, across rooms near the ceiling, and, of course, on the Christmas tree, Usually the tree in the center of the interior lighting scheme, although it can be supported by lighted vases, pictures, potted plants, and table fountains. To decorate the center of the Christmas dianer table, you can use a miniature ice mountain on a large platter. The lamps can be of the usual Christmas-tree type, or several radio diallight or flashlight bulbs may be used, wired in parallel and lighted by a doorbell transformer or botteries. Pile ice cubes over the lamps. If you are careful, you will not need to provide guards for the bulbs

You may experience a little difficulty to connecting outdoor legiving equipment to your house circuit. Usually the problem can be solved by running one or more subbercovered tables from an interior source of current. A simple way of petting the ware outdoors is to cut a board about 3 in. wide and long enough to extend across the bottom of a window when the sash is raised. Bore a hole or cut a notch in the board for the wire Lower the sash against the board and insert a stock above the sash to lock the window, if no other locking device is provided for this purpose.

The following table is a guide for the proper selection of wire to be used in Christmus lighting layouts and will enable you to avoid overheating and loss of voltage and consequent lamp brilliancy through use of top small wire:

WIRING TABLE

(Rubber Covered Wire)
Length of Run in Feet

				m	mi			
	arta j			137			250	
10	20	14	24	14	14	14	341	0.65
40	10	14	14	14	14	14	-14 (Caree .
5(00	14	14	14	12	17	10	H. R. S. Gane Number
				12			- 1	

For larger loads, one more circuits, in accordance with recommendations of your local electric company or contractor

Note: The author wishes to acknowledge the engritery of the General Electic Company in providing see all the photographs used on source 64 and 65



... Your copy of the 1933 Home Workshop INDEX

OW often have you hunted through your back copies of Popular Science Monthly to find some home workshop article you distinctly remembered seeing? And what a job it was! No one ever realizes what a wealth of material is published in this magazine until he has to go through a number of issues to find some particular item.

You can save yourself all this trouble by using the Home Workshop Annual Index. This lists alphabetically every article published on craftwork, shop methods, house repairs and short cuts, model making, radio, automobiles, and such hobbies as chemistry, microscopy, and astronomy

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QUICK STARTS ON COLD MORNINGS

(Continued from page 60)

to a thizper oil and you won't put such a beavy load on your starter and battery and the moving parts will get better lubri-CLUOD."

"Speaking of batteries, Gus," interrupted Yolan, "mine is always going dead in the winter. I can't seem to keep it up to charge,

and we don't use the car much."
"That's the answer," Gus explained. "Besides, you probably do all your driving at might. With parking and everything, your generator doesn't get a chance to charge the

CAN'T I get around that some way?"
Nolan asked. "I can't be trotting my battery to a service station every week."

You wouldn't have to if you did some daylight driving," replied Gun, "But increasing the charging rate of your generator will help some."

"How do you do that?" Nolan asked, I'll do it for you," offered Gus. "Then you'll know how it's done. But first of all, we've got to make sure your ballery isn't too bailly discharged. You get your hydrom eter and test the unitery readings while I run out to the service car and pick up a screw driver and a pair of pliers"

"Battery seems O. K.," Nolan reported when Gus returned, "Reads almost full change."

Gus bent over the forward part of the motor and bited a metal cover from the rear end of the generator. The commutator and its brushes were in phin view

Indicating one of the brushes, Gus said, This one is called the third brush and regulates the generator. To change the amount of current the generator pushes into the battery all we've got to do is move it along the commutator one way or the other By the way, what a the highest charge reading von gel on your dash ammeter?

"Oh, about eighteen amps," Nolan te-

For winter deving in this car at ought to be about twenty, so we'll increase it two

Gus homened the adjusting screw on the aide of the generator housing and pushed the brush toward the motor block 'Moving it this way increases the changing rate he explained. "Moving it the other way decreases it

That pught to do it." be added as he fitted the cover back in place. "Now let's take ber out for a lest run and see how near I came to hitting it on the nose."

Nolan grinned with saturaction as the motor started with the first effort

As they gamed speed, Gus watched first the ammeter and then the speedometer When the dial showed twenty five miles an hour, he nudged Nolan and pointed at the ammeter, "Just about twenty amps," he said. "That'll help your battery some, but don't forget to charge it back to pormal when spring comes around."

"DY THE way, Gus," Nolan said as the car coasted to a stop in the driveway. "you haven't tipped me off on any tricks I can use when the motor won't start."

'Hot water poured over the intake manifold will generally make even the coblest car perk," Gus replied, "And if that doesn't work, you can always pour a little ether into the air intake of the carburetor.

"But the important things are good gas, a bot spark, winter oil, and a fully charged battery And incidentally," he added with a wink. "if you'd fit that parage of yours with insulating board, you'd find the old bus wouldn't get so cold."

Patents



ow Mr. Attorney . . what do you think of this idea?

THAT'S what invenion most often ask of me-or of any Patent Attorney, They want our op, mon of the webet, the "sale-ability" of their ideas. Often what they ready want is encouragement. They long to have someone support their own belief - secret or otherwise-that "there a millions in it."

Now no one ever asks a doctor whether or not a newborn baby will grow up to be a poet or a banker or an engineer The doctor's business is to take care of the baby professionally after its advent. and treat it for any adment that may be present.

The Patent Actorney's business is to make sure, so far as be can, that all legal requirements have been met and covered in his client's Patent Appucation, and then to give his experienced, whole hearted assistance to help obtain the best Patent procumble.

"Encouragement" Is Too Often Misleading

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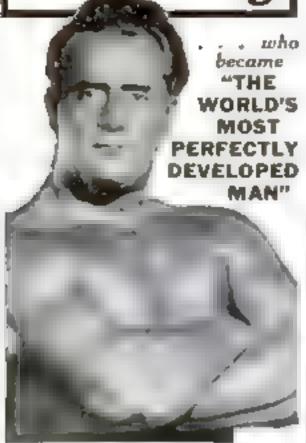
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By CHARLES ATLAS

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Constructing a Light, Adjustable

Drafting Table

for Home Workshop Use



Light as it is, this drafting table is atteng, rigid, easily ad used, and web iduminated

By Leslie M. Holbrook

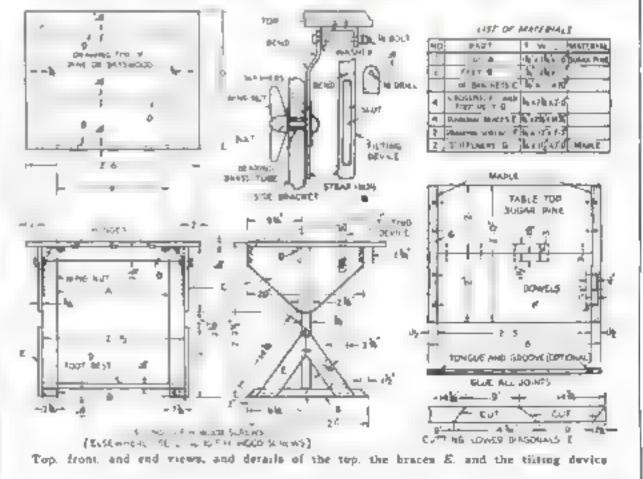
A HANDY all-purpose drafting table is a necessary part of the home craftsman's equipment. The table described here, although extremely light, is rigid and strong and requires a minimum of space.

For the top you may use an ordinary drawing board of pine or basswood, or make one from sugar pine as shown. The stand is also constructed of sugar pine. To assemble the end frames fasten foot B to the leg A with 33%-in. No. 10 wood screws and glue. Then select two of the diagonal braces E and fasten them as shown in the side elevation. Side bracket C should be cut as suggested in the same view unless you desire to mount a cabinet on the stand for supplies; in that case the ends may be left straight. Fasten C to



The top is attached to the framework with three bress kinges. Note the lamp bracket

leg A with glue and four wood screws. Then assemble all with crosspleces D and add the foot rest where most comfortable.



ACCIDENTS PRODUCE GREAT INVENTIONS

(Continued from page 41)

discovered the secret of developing tintypes. It was in the course of an experiment that Becquerel put a quantity of unanium and a photographic plate together in a drawer, and so opened the way to the tremendously important investigations of the radiation of UELD AM.

ANTHRACITE as a fuel, or rather, the fact that anthracite will burn if given time to fire up, was discovered by a man who was experimenting with hard coal. He was about to give it up for a bad job when, one day, in the maist of a test, he was called to dinner and forgot to extinguish the fame of the kindling. Lake Mason, the grainlessboard man, he received the surprise of his life when he returned and found a hot bed of coast! Even the nameless medieval Getman monk, who, in his innocence, unleashed the fury of gunpowder upon the world and unwittingly changed the entire course of history, did so when he mixed charconl, sul-phur, and sultpeter in a mortar while conducting some obscure alchemistic experiment

Hat there is another type of chance lavention—the purely accidental kind. This, of course, occurs much more rarely and, like lightning, may strike anywhere. Such a discovery may result from a flash of insight by an intelligent person observing a matural phenomenon or a utuation in the world about him; or it may be made just by dumb luck

or even through a mistake

An error on the part of a workman at the Centennial Exposition in Philadelphia in 1876, was responsible for one of the most important and far-reaching discoveries ever made. The man had been told to provide ertra electric current for a circult by start ing two dynamos and turning the current from both an to the circuit. Forgett ag the proper procedure, he connected both dynamos to the circuit and then started the engine driving the first dynamo, Instantly, the other dynamic started by kward tutti ng an on electric motor, the world's brit electric motor capable of doing work?

Unfortunately for that workman and his descendants, he either never tried to patent his electric motor or perhaps employed an incompetent patent attorney who failed to secure for him the kind of petent that would have been worth millions of dollars.

It was a chance conversation with one of his master's passents that put Edward Jenner on the track of his ejech making discovery of sing post varranal in At the time. about 1770, Jennet was articled, that is, apprentsced, to a surgeon at Sudbury, near Bristol, England. One day, a young countrywoman came for some cough medicine. While chatting with her, Jenner casually mentioned smallpox, and the girl remarked that she could not get it because she had had cow-

pox which made her immune.

In this accidental manner, Jenner learned of a popular notion in the district to the effect that milkers infected by a peculiar eruption that sometimes occurs on the cows udder, were immune from smallpos. Medical men whom Jenner consulted dismined the idea as a superstition, but the apprentice surgeon had a mind of his own. He then and there began the series of sensational experiments that led to his great discovery

HAPPILY it is not necessary to go back to the engbleenth century to find examples of discoveries made by pure chance A brand-new invention that may revolutionue automobile night-driving, resulted from a change observation by a keen-witted acquaintance of more. Walking along the main street of his small native city one evening not long ago, he was amazed to notice that the dazzling glare of a street light desappeared when he passed a certain spot and teappeared a few feet beyond. He retraced his steps, and the same thing happened. His first thought was that some rope or rod might intercept the glare, but careful inspection (affed to reveal any such obstacle protruding between him and the source of the light

HE spot where this curious phenomenon occurred was in front of a brightly lighted drugstore with two show windows Despite unconcealed curiosity on the part of a group of townstell waiting for a streetcar at that point, my friend again walked back and this is what he found

When he stood in the red light shining from one of the drugstore windows, the gare of the street lump was almost unbewable. When he stood in the green light shiming from the other window, the glare disappeared

Continuing his walk, he deliberately looked for an automobile parked at a drugstore Naturally, he was not long finding one. He tested the effect on his eyes of the glare of its headlight, first by the red and then by the green light of the store. He was satisfied. By the red light, the clare was almost insufferable, but disappeared when the green light shone across his line of vision. The next few months my friend devoted to applying his discovery to a practical invention. His patent has been applied for, and is expected to be tastier soon.

It is the fushion nowadays, as I observed at the beginning of this article, to believe the element of chance in invention. One way in which this attitude is expressed, is in the debunking of atories about famous accidental discoveries, in which the men of my generation believed implicitly when they were boys

These atories, we now are told, are mere ly legends, belonging in the same class athe anecdote of George Washington and the cherry tree. All right, But even so, thence always has played and always will play an important and thrilling part in the life of the inventor, and lends it a glamour no other element could supply. It ever you doubted this, you never will again after reading how Senfeider discovered the principal of hthography. Here it is-not a legend or an old wives' tale, but the undisputed story of this remarkable discovery as told in the insen or a own words

I had just succeeded in polisbing a stone plate which I intended to cover with etching ground, in order to continue my exercises in writing backwards, when my mother entered the room and desired me to write her a bill for the washerwoman, who was waiting for the linen. I happened not to have the smallest slip of paper at hand as my little stock of paper had been entirely exhausted by taking proof impressions from the stones nor was there even a drop of lak in the faks-

AS THE matter would not admit of deto send for a supply of the deficient matereals. I resolved to write the list with my ink prepared with wax, soap, and lamp-black, on the stone which had just been polished, and from which I could copy it at leisure.

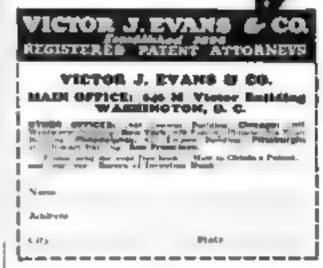
"Some time after this, I was just going to wipe this writing from the stone, when the idea all at once struck me to try what would be the effect of such a writing with my prepared ink if I were to bite in the stone with equalories, and, having better away to about the hundredth part of an inch, I found that I could charge the lines with printing lak, and take successive impressions."

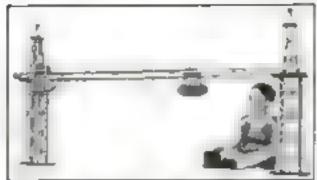


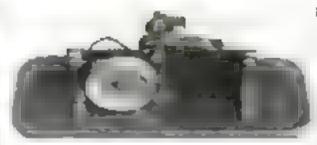
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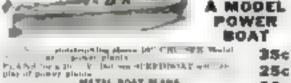
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DOCTORS FACE DEATH TRAILING POISONS

(Continued from page 15)

surrounding envelope that aids them to adhere and form nests of colonies which in certain stages are visible under the micro-

Another fuscinating drama of courageous research is connected with the name of

Rocky Mountain sported fever

The work or fighting this disease was largely carried on by Dr R. R. Spencer, of the United States Public Health Service. For a long period of time he worked with the disease daily, handling germ cultures so deadly they claimed the lives of four laborstory workers. Tedious and balling were the experiments, for the germ cluded discovery, but at length Dr Spencer succeeded in developing a vaccine with which he was able to immunize guinea pigs and monkeys.

Now he was ready to try it upon a httman subject. Making a culture from ground-up infected wood ticks, he inoculated harmelf by taking the virus directly into his own blood. Then, as the discuse began to make its appearance, he paye himself the

protective vaccine

The remedy proved its worth. Dr Spen cer recovered without serious consequence. Since then, more than 40,000 people have

been protected by the vacrons

To probe the riddle of the virus, the ultraviolet microscope is being used. Invisible rays of black light register upon photographic plates details too small to be seen otherwise. Two British experimenters recently thus succeeded in finding a previously invisible organism connected with the mysterious Rorna disease, a sickness of horses

It is known, however, that bacteria produce a mysterious chemical which rapidly spreads in body tissues to break down natural resistance against disease, paving the way for germs and their infection. Recently a synthetic chemical with similar properties has been produced at the Rockefeller Institute and given the imposing title of p-diago-bengol-sulfonic acid. Injected into the skin, with a little India lak dissolved in it us a marker, the acid spreads with astonishing rapidity covering at much as a square foot under the skin. Some such discovery may one day enable experimenters to penetrate the secret of the fitterable virus

ULTRA-SHORT-WAVE RADIO FOR AMATEURS

(Continued from page 50.

Considered is one way it has many advantages. over the five-meter section. For besides its line-of-sight ground wave it also exhibits a Heaviside-layer wave that often turns up a great distances from the transmitter

Although super-regenerative receivers also give the best results on ten meters, it is sometimes possible, providing the conditions are just right, to bring to the stenais on an ordinary short-wave receiver equipped with a ten-

Along this line, readers who have constructed the Popular Science Monthly short wave receiver (P. S. M., Apr. '32, p. 72) can try their luck with the ten meter band by temporarily altering their twenty meter coil. The simplest way to do this is to tap the coll at the second or third turn to short out the remainder of the winding. This will cut the five turn coil down to approximately two and one half turns.

Plug the altered roll into your set. If the internal conditions in the set are just right. you will be able to listen in on some of the ten-meter activities and see for yourself how

popular this band is becoming

YFE5-SAW-QT98

CHECKING UP ON TIME AND SEASONS

(Continued from page 39)

apart. When it is noon in New York, it is twelve minutes past noon in Boston. When it is noon in New York, it is twelve minutes before noon in Washington, D. C. In latitude forty degrees north, about twelve miles of east-west distance gives a difference of one minute of time. If every station along a transcontinental railroad should keep its own solar time, there would be endless confusion and danger in running trains,

STANDARD time solved the problem by adopting the local or solar time of each hourly meridian as the standard of a strip of land about 750 miles wide. The local time of the Philadelphia meridian became Eastern Standard Time; the solar time of St. Louis became Central Time; and so on. The time roses are not, however, bounded by straight north and south Ezes; the boundaries are more or less zig-rag, depending upon the presence of mountains and the end of milroad divisions.

The type of sundial which is the ensiest to build, as well as the most nearly accurate, is shown in one of the illustrations. The lengths of the divisions on the semicircular arc are all equal, from 6 A.M. to 6 F.M. The wire that custs the shadow should, of course, be placed at an angle with the ground equal to the latitude in which the dial is to be used. The wire will then be parallel to the earth's main-

The principal reasons for the warmth of summer and the chill of winter can be made clear by a simple experiment. A globe

mounted upon an axis inclined twenty-three and one-half degrees to the vertical is turned so that it leans toward a flash light representing the sun. This indicates the earth's position at midsummer. When the square beam of light passing through a hole in a card falls apon the United States, it is concentrated upon a spot almost square. Its heating effect is therefore intense.

When the identical square beam is turned upon the United States with the carth's axis slanted away from the flash-light sum (its midwinter position) the light is spread out over a reclangle much larger in area than the square. The light is accordingly diffused over more ground and its heating effect is

correspondingly lessened.

The illustrations giving top views of the earth is its summer and winter positions show additional reasons for the warm and cold sessons. In summer, with the earth's axis slanting toward the sun, the light and heat are received by a place in the northern bemisphere during the hours of a long day. The place gets a chance to cool off only during the short summer night. The opposite condition, of course, occurs during the short days and long nights of winter,

IN THE next article, a few common objects on a table will show us how star distances are measured; lumps of day will illustrate how the moon was probably born from the earth; and a few books and two strips of tape will enable us to measure the moon's diameter.

COSTLY FUR FROM CHINCHILLA FARMS

(Continued from page 31)

nearby Molinos, on the western border of La Piata, one man exported 3,000 dozen pelts annually for years. But the trade had languished, for the chinchillas had gradually

disappeared from that region-

"White men cannot travel into the country where the chinchillas live," Chapman told me, "When I first became interested in them, I sent out a couple of Indians to bunt them. Soon I had twenty-three Chilenns and In-dians on the trail. Yet the set result of all that hunting was a docen animals. I finally left South America with eleven animals; and arrived at Los Angeles with a dozen. An expectant mother had given birth to two while on the high seas and we managed to save one of them.

Y CHINCHILLAS came from the MY CHINCHILLAS came from the province of de Altacama. I lived at an altitude of 11,300 feet but the trappers went a mile higher. Strange as it may sound to people unaccustomed to living in the wild, they actually caught several with their hands. The chinchilla is one of the most curious animals alive. Fire a gun and he runs into his hele; but a moment later you see his little head sticking out as he looks around the mountain.

"The hunters take advantage of this curiosily and often take a seat in front of a hole and wait for hours, hoping a chinchilla will make a personal appearance. Sometimes their patience was rewarded as a chinchilla would emerge slowly from his hole and crawl over the leg blocking his path. Then the trapper would grab and grab quick, for a chinchilia is us quick as a rabbit, though he can't run as fast."

Through a combination of circumstances. Chapman, who as a youth raised rabbits

and sowirrels for their hides at Grants Pass, Ore., was set down where chinchillas were considered to be as abundant as anywhere on the continent. Meantime several expeditions had spent fortunes in a fruitless effort to catch and transplant several pair to the United States or to Europe.

Undismayed by the many failures of which he had beard, Chapman continued his search. At last, his runners brought him eleven grown animals. For two years he kept them at an altitude of 11,000 feet, studying their habits, watching over their health. Then he carried them down the mountain and stopped a year 8,000 feet above the sea. As the fee began to thaw after the third year, he loaded them in wire cages, strapped them on the backs of burros and completed the journey to the sea.

THE worst part of the long trip lay ahead, the sea voyage. He boarded a steamer from Iquique, Chile, with the little fellows panting for breath. Accustomed to thriving in freezing gales far below zero, they suddenly were catapulted into a summer heat none ever had experienced. For forty days and nights, Chapman kept them in vartual refrigerators -ice-chilled cages curtained with moist canvas. Yet they suffered so that many times during that trip he applied ice packs to their heads as various animals passed out in the heat-

"To complicate matters," Chapman commented wryly, as we squatted over one of

his finest pairs at his Inniewood, Calif., ranch, "when only four days out from California they shed their fur and we had to wrap the whole batch in blankets to keep them from freezing. At last, after what seemed an eternity, we landed a dozen under permit of the U. S. Biological Survey, the first, and last, to reach the United States alive."



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How a Veteran Pilot Flies Down Radio Beam

nor dangerous now. Our position is known every second as definitely as though the ship were standing alongside the runway. All I did was swing the plane into a bank and circle downward to the left. That way I would be on the low side when at last we broke from the log.

From here to the bottom, the story be-

longs to Ables.

YOU just passed the administration building," said the voice, bidden down there beneath the heavy canopy of musture. "You are now east of the field . . . you are northeast ... north ... northwest ... over Wilson's nirport ... blimp your engines, Dick ... cannot hear you."

I flew the ship in an easy circle, bearing always to the left. Occasionally the wind would carry the engines' sound away from the airport. Then it was Joe would ask me to speed up the motors. Sis times I circled, as the song of the ground man poured incessantly into my ears. As he talked, he beld two telephones to his ears. One was connected directly with me; the other with the operations office, where a radio operstor stood vigit. In case Joe missed part of a message from one, he needed only to speak into the second phone to the operator, who also heard our convensation as it proceeded.

"South of field . . . southeast . . . east . . I still could not see unything below when Joe's reassuring voice said: "You have good altitude and should see the field at 900."

Quick calculation told me my altimeter should read about 1,600 feet when at last I would break through the floor of the fog, for the airport Itself her 700 feet above the sea. The voice talked incessantly as I wound around the firld. At last, three minutes after we arst plunged in, he said:

"I can see you Dick. You are on the

west edge of the field."

Confidence! Who could ask for more? There I was, blind; yet a man nearly a mile distant, standing securely on the ground was acting as my eyes. He directed every move, even when I was totaly obscured; now he could see me, give me that reassurance on the threshold of the earth's reappearance to the passengers which they had seen last a hundred miles distant,

"Okey," I said distinctly into the mike when, a few seconds later the field lights

burst into view, "What's the wind?"

Two minutes later I set the ship down into a seven-mile wind and the pussencers disembarked little thinking that the resources of science had made possible for them a safe and uneventful flight that would have been impossible as recently as three years ago,

When the public comes to realize as do L. the wonders of radio and meteorology, they will marvel at the extraordinary novances that have taken place since I first began to fly mail planes along the Parific Coast only six years ago. We think nothing new of taking off blind at midnight, pulling up through a heavy layer, and pounding about on schedule.

YET there is no chance in these opera-We are guided by fixed inflexible rules. We know from many obacryations and reports of ground men, what to expect ahead.

For instance, I landed at Bakersfield not long ugo, warned by radio, that the mountains were closed in by a severe storm. Above and as far routh as the eye could see stars twinkled merrily and cast their pale light on the countryside. Yet down we sal-

One passenger protested. "Young fellow," he expostulated, "any fool can see we've got good weather. You must be an amateur or you would carry us on to Les Angeles."

I explained politely that I had spent some 5,000 hours in flying over this route, that when the mountain stations reported impassable storms, those storms were impassable as far as I was concerned. After a three-

hour delay, we firm over safely.

We always land at some intermediate field when the crackling radio wards of hazardnus storms ahead, for a heavy responsibility rests on the paot. From two points of view, sale performance towars his bread and butter: his Reeuse and his job. After all, the number of transport piluts is small. Fewer than 850 fly for the airlines and our emplayers keep close tabs on us.

The passenger cannot understand why, one day, we will climb above log and fly a long distance with the earth obliterated and, on another, will decline to take off under a blue sky. Yet the dight over the mountains that night would have been dangerous, whereas o few weeks later I flew fully an hour through dense for to Oakland, safely follow-

ing the beam.

We are required to train periodically under the bood," taking off, navigating, and landing by instruments in order to be fully qualified to meet blind conditions. We do not call it blind flying now, for radio and instruments combined enable us to see

> Good News for HOBBYISTS

An announcement of importance to all those who have home workshops or pursue any branch of the manual arts for amusement, is published on pages 62 and 63 of this issue.

POPULAR SCIENCE MONTHLY has offered its name and its prestige to the great movement described on these pages and it is the earnest and confident hope of the publishers that the readers of this magazine will take a leading part in effecting the successful organization of the projected national association of amazeur craftsmen.

very well. Every transport pilot is fully qualified to maneuver safety by instruments.

We older pilots have been flying by instrument for years. I long ago quit worrying about flying with one wing low. If the compass should swing off five degrees, indicating I had turned a little off course, I knew it soon would swing back again. Nature has a way of compensating for these

But today the Department of Commerce inspector who checked me for instrument flying spoke frequently through tubes, warning me to keep the ship in level flight. Nor do aerobatics have any place to transport flying. We keep the ship level always, under all conditions.

We used to fly by the "scut of our pants." Now in flying the beam, we must pay close attention to the position of the ship, for the beam is narrow. Two miles from the station, it measures only 100 feet in width and is only seven miles wide a hundred miles

Sometimes the beam shifts and wraves. particularly at suarise and susset. Yet it leads inevitably to its source. No matter

whether we fly 1,000 feet or 20,000 feet high, the din of the beam beats constantly on our cars.

The beam and accurate instruments got me through a storm safely one night. Shortly after I left Merced, with a half-hour to go to Unkland. I encountered bad weather. I started to pull up, hoping to fly above it, but the plans began to pick up ice at 5,000 feet. I nosed het down to 4,000, realizing this would be a safe altitude to escape the ice and to clear the Livermore

Then I tuned in the Oakland beam and set my course directly for the field. A half-hour passed, forty minutes, fifty. Sull no Oakland. I resbeed I was flying into a head wind, since the storm was moving southward, and knew I had no cause to worry. Steadily the engine druned on and one hour after I had entered the stuff, the beam sud-denly died. I was over the wide cone of allence. A voice from the ground then directed me down in a stow spiral and I landed. An hour later three-eighths of an inch of ice still clung to the wings.

Had it not been for the beam, I should never have attempted that flight with the night mail; yet it was far safer than many flights I made in the earlier days under more favorable conditions. Three years ago I would have turned back at Merced and set the mail down at Fresno, to be delivered

by truck.

Sometimes we will not carry passengers even when the observers report fog at comparatively low attitudes on the north side of the Tehachapi, for we look beyond the formal reports into experience. Occasionally high pressures on the desert toward the east will draw air over the mountains, bringing the for and clouds down in a torrent. One night, flying without passengers, I hit this wind. Soon I noticed the fog drifting forward under my wings, moving even laster than my speed, then 120 miles an hour.

Curious, I thought; almost unbelievable. To check the speed of the scurrying mass, I nosed the plane down, picking up a speed of 150 miles an hour. Still the fog outraced me. Not wishing to be thought silly, I checked the movement on two later occa-sions before reporting it. Then I learned other pilots had had the same experience.

The for rushes to the desert, strikes the bot air, and becomes dissipated, disappearing suddenly in thin air. It is one of the oddest phenomena I have ever witnessed from an airreane at midnight!

Not infrequently the same meteorological conditions will cause the wind to behave similarly, though there are no clouds.

The great speed of our newer planes, fully fifty miles an hour faster than the ship in which I made the Merced-Oukland flight, will enable us to outrace sudden disturbances. Here, at fast, are vehicles of the air that approach closely self-flying, though they are not yet equipped with sobol pilots. Twenty-one instruments and thirteen controls, all operated from the cockpit.

Landing lights, set permanently within the Wings, cast brilliant rays through thick glass shields. Landing gear disappears within the wing during flight. Under the none of the plane is an electrically-heated pitot tube by escans of which air speed is measured. No ice will collect here to prevent proper functioning. By adjusting flaps fixed to the trailing edges of wings, rudder, and flippers we can trim the plane in flight to hold up a heavy wine, set our course in a cross wind, or hold the plane level with varying panerger loads.

And speed! For the first time passenger planes find their cruising speed jumped up suddenly nearly fifty miles an hour. A new era for scheduled flying has arrived.

Cappy great custs





Steady Smokers turn to Camels

"I know of no sport," says Erich Hagenlocher, "that places a greater strain on the nerves than tournament hilliards. The slightest inaccuracy can ruin an important run. One simple rule for success is, 'Watch your nerves!' I have smoked Camels for years. I like their taste better and because they're milder, they never upset my neryous system,"

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